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No. 1. — *Reports on the Results of Dredging, under the Supervision of* ALEXANDER AGASSIZ, *on the East Coast of the United States, during the Summer of* 1880, *by the U. S. Coast Survey Steamer "Blake,"* COMMANDER J. R. BARTLETT, U. S. N., Commanding.

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XVII.

Report on the Crustacea. Part I. DECAPODA. *By* SIDNEY I. SMITH.

THE part of the following report relating to the Macrura was ready for the printer before Alphonse Milne-Edwards's *Description de quelques Crustacés Macroures provenant des grandes profondeurs de la Mer des Antilles* (Annales Sci. Nat., Zool., 6me série, XI. No. 4, 1881) was received, so that all the references to it have been added subsequently. The new species in this and some other recent papers of Milne-Edwards, and in Bates's recent paper on the Penæidea, are so imperfectly characterized that in several cases I have found it impossible to determine, with any approximation to certainty, whether or not they are identical with species described in the following pages. I have endeavored, however, to make the descriptions and figures of the species here described so complete, that subsequent investigators will not labor under a similar difficulty in regard to them.

BRACHYURA.

MAIOIDEA.

Amathia Agassizii, sp. nov.

Plate II. Figs. 2, 3.

Resembles *A. Carpenteri* Norman (figured by Wyville Thomson, Depths of the Sea, p. 175, 1873), but has shorter rostral horns and more numerous spines upon the carapax.

The carapax is sub-triangular, excluding spines and rostral horns, nearly

four fifths as broad as long, or with the breadth including spines about equal to the length excluding the rostral horns, which are strongly divergent, nearly straight, and in the adult less than half as long as the rest of the carapax. The supra-orbital spines are large, acute, and much more prominent than the obtuse post-orbital processes. The basal segment of the antenna is armed with two large and nearly equal spines beneath the eye, one near the base, the other near the tip. The hepatic region projects above the lateral margin in a prominent spine about a third of the way from the orbit to the great branchial spine. The anterior angles of the buccal area project in angular dentiform processes, back of which the prominent margin of the pleural region is armed with two or three small and unequal spines. There are six spines or spiniform tubercles on the gastric region, two median, and each side two slightly smaller lateral, which are nearer together than the median. There are three median spiniform tubercles on the cardiac region, of which the middle one is much the more prominent, and back of these the posterior margin of the cardiac region projects in a prominent median spine, either side of which the postero-lateral margin is ornamented with a regular series of six or seven minute tubercles. The middle of the branchial region projects in a spine directed straight outward and a little upward, which is the largest upon the carapax, and about half as long as the rostral horns ; on a line between this and the postero-lateral gastric spine there are two spines near together ; and back of these on the posterior part of the region there is a single spine opposite the large cardiac spine. In addition to these dorsal spines of the branchial region there is a lateral closely set series of three or four small spines just below the pleural suture and above the base of the cheliped, and a similar but isolated spine below and back of the great branchial spine. The entire surface of the carapax and of the sternum, and of the exposed parts of the appendages, except the terminal portions of the chelæ and of the dactyli of the ambulatory legs, is covered with soft scabrous papillæ, and sparsely clothed with short setæ.

The chelipeds are a little longer than the carapax including the rostral horns, and scarcely stouter than the ambulatory legs ; the chela is nearly as long as and no stouter than the merus, the basal portion subcylindrical, nearly naked and smooth except for minute, scattered papillæ, like those on the surface generally except that they are smaller and much more scattered ; the digits are a little more than half as long as the basal portion, a little curved, slightly compressed, smooth, and with the prehensile edges regularly dentate. The ambulatory legs are all armed with a dentiform spine at the distal end of the merus ; the first pair are nearly twice as long as the chelipeds, and the succeeding pairs are successively a little shorter.

The second and third segments of the abdomen of the male are expanded, and the first and second are each armed with a small median tubercle.

Station 319, N. Lat. 32° 25′, W. Long. 77° 42′ 30″, 262 fath. ; 1 ♂.

A very much smaller specimen (Plate II. fig. 3) from Station 317 differs so much from the one above described that it might readily be mistaken for a distinct species. It is apparently an immature male, and differs in having a

narrower carapax, with much longer rostral horns and fewer and much longer spines.

The carapax, excluding the rostral horns and lateral spines, is about two thirds as broad as long; the rostral horns are as long as the breadth of the carapax excluding the spines, nearly straight, slender, and very acute. There are two spines upon the basal segment of the antenna, but the proximal is much smaller than the distal. The hepatic spine is slender, and about a fourth as long as the rostral horns. There is only one small spine, or one with the rudiment of a second, on the margin of the pleural region back of the anterior angle of the buccal area. The two median spines of the gastric region are slender and conspicuous, the posterior much the larger, but there are no lateral spines. The middle spine of the cardiac region is as long as the hepatic, and in front of its base there is a rudiment of a second; the posterior cardiac spine is slender and very little shorter than the hepatic, but there are no spines or tubercles either side its base. The middle spine of the branchial region is slender, and more than half as long as the rostral horns; there is a single small spine in place of the two anterior branchial; a small posterior branchial is present; and in place of the series of small spines there are two very minute tubercles.

The chelipeds and ambulatory legs are nearly as in the other specimen, but the chelæ and the dactyli of the ambulatory legs are a little more hairy.

Station 317, N. Lat. 31° 57′, W. Long. 78° 18′ 35″, 333 fath.

The two specimens give the following measurements.

Station	319	317
Sex	♂	Young
Length of carapax including rostrum and posterior spine	35.2 mm.	13.1 mm.
Length of carapax from base of rostrum to tip of posterior spine	27.5	8.4
Length of rostral horns	8.5	5.1
Breadth of carapax, including lateral spines	27.0	10.5
" " excluding " "	20.3	5.1
Length of branchial spine	4.5	3.0
" cheliped	37	8
" first ambulatory leg	63	16
" second "	43	13

Since the above was written several specimens of this species have been taken off Martha's Vineyard by the United States Fish Commission. All these specimens are intermediate in size between those above described, and show that they are really, as supposed, stages of growth of a single species.

Hyas coarctatus Leach.

One young specimen, Station 301, N. Lat. 41° 26′ 55″, W. Lon. 66° 3′, 71 fath.

Euprognatha rastellifera Stimpson.

Stimpson, Bull. Mus. Comp. Zoöl., II. p. 123, 1870.
A. M.-Edwards, Crust. Région Mexicaine, p. 183, Pl. XXXIII. fig. 2, 1878; Bull. Mus. Comp. Zoöl., VIII. p. 7, 1880.
Smith, Proc. National Mus., Washington, III. p. 415, 1881.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
335	38° 22′ 25″	73° 33′ 40″	89	1 ♂.
345	40° 10′ 15″	71° 4′ 30″	71	70 ♂ ♀.
346	40° 25′ 35″	71° 10′ 30″	44	1 ♀.

This is apparently by far the most abundant of all the Brachyura along our whole eastern coast south of Cape Cod in the belt from 50 to 200 fath. depth. In the U. S. Fish Commission dredgings off Martha's Vineyard, many thousands of specimens were often taken at a single haul of the trawl.

CANCROIDA.

Cancer irroratus Say.

Cancer irroratus Say, Jour. Acad. Nat. Sci. Philadelphia, I. p. 59 (♂ only, ♀ being *C. borealis*), Pl. IV. fig. 2, 1817.
Stimpson, Ann. Lyceum Nat. Hist. New York, VII. p. 50 (4), 1859.
Smith, Trans. Conn. Acad., V. p. 38, 1879.
Kingsley, Proc. Acad. Nat. Sci., 1879, p. 391, 1880.
Platycarcinus irroratus M.-Edwards, Hist. Nat. Crust., I. p. 414, 1834.
DeKay, Nat. Hist. New York, Crust., p. 6 (in part), Pl. II. fig. 2, 1844.
Cancer Sayi Gould, Invertebrata Massachusetts, 1st ed., p. 323, 1841.
Platycarcinus Sayi DeKay, *op. cit.*, p. 7, 1844.
Cancer borealis Packard, Memoirs Boston Soc. Nat. Hist., I. p. 303, 1867.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
314	32° 24′ 0″	78° 44 0″	142	2 ♀.
327	34° 0′ 30″	76° 10′ 30″	178	6 ♂, 2 ♀.
333	35° 45′ 25″	74° 50′ 30″	65	1 ♂.

The occurrence of this abundant shallow-water and littoral northern species in deep water south of Cape Hatteras is very interesting. As a littoral species it is apparently not abundant south of Cape Hatteras, and on the New England coast fully grown individuals are certainly rare below twenty fathoms. The alcoholic specimens from deep water are lighter in color than similar specimens from shallow water, but this may be partially due to the fact that they are entirely devoid of all algoid growths which are common on shallow-water individuals; and the edges of the carapax appear more acutely dentated, which is easily explained by the fact that they are not subjected to the abrading influence of sand and gravel as the shallow-water specimens are. The following measurements show no appreciable difference from shallow-water specimens in the proportions of the carapax.

Station.	Sex.	Length of Carapax.	Breadth of Carapax.	
333	♂	25.0 mm.	38.7 mm.	= 1.55 lgth.
327	"	36.3	56.0	1.54
"	"	37.2	59.0	1.59
"	"	37.2	59.1	1.59
"	"	40.5	64.8	1.60
"	"	41.0	64.8	1.58
"	"	59.7	94.0	1.59
"	♀	39.0	61.5	1.58
"	"	39.1	62.0	1.56

Cancer borealis Stimpson.

Cancer irroratus Say, Jour. Acad. Nat. Sci. Philadelphia, I. p. 57, 1817 (♀ only, ♂ being *C. irroratus*).

Gould, Invertebrata Massachusetts, 1st ed., p. 322, 1841

Stimpson, Invertebrata Grand Manan, p. 59, 1853 (*teste* Stimpson).

Platycarcinus irroratus DeKay, Nat. Hist. New York, Crust., p. 6 (but not the fig.), 1844.

Cancer borealis Stimpson, Ann. Lyceum Nat. Hist. New York, VII., p. 54 (4), 1859.

Smith, Inverteb. Vineyard Sd., Report U. S. Fish Com., I. pp. 546 (252), 745 (451), 1874; Trans. Conn. Acad., V. p. 39, Pl. VIII. 1879; Proc. National Mus., Washington, III. p. 417, 1881.

Kingsley, Proc. Acad. Nat. Sci. Philadelphia, 1878, p. 317 (2).

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
314	32° 24′ 0″	78° 44′ 0″	142	1 ♂, 3 ♀, 3 young.
321	32° 43′ 25″	77° 20′ 30″	233	6 ♂, 4 ♀.
327	34° 0′ 30″	76° 10′ 30″	178	3 ♂, 1 ♀, 8 young.

Fifteen of the specimens give the following measurements.

Station.	Sex.	Length of Carapax.	Breadth of Carapax.	
314	Young.	15.2 mm.	21.5 mm.	= 1.41 lgth.
"	"	16.7	24.3	1.45
321	♀	22.3	33.2	1.48
"	"	25.3	38.0	1.50
327	"	47.0	73.0	1.55
314	"	49.3	76.0	1.54
321	♂	32.5	49.0	1.51
"	"	38.0	59.5	1.56
314	"	46.0	72.0	1.56
327	"	47.0	74.5	1.59
321	"	47.6	75.5	1.59
327	"	63.0	101.2	1.60
"	"	76.0	120.0	1.58
314	"	78.0	123.0	1.58
"	"	80.0	129.0	1.61

This species has also been taken in considerable abundance, in 50 to 200 fathoms, off Martha's Vineyard, by the U. S. Fish Commission. The remarks under the last species in regard to coloration, acuteness of the dentation of the edge of the carapax, etc., apply equally well to this species. The fact that this species and *C. irroratus* as well are regular inhabitants of the deep water off our southern coast is sufficient to account for their occasional occurrence in shallow water at the Bermudas, and even in the West Indies.

Cancer Bellianus Johnson (Proc. Zoöl. Soc. London, 1861, p. 240, Pl. XXVIII.) from Madeira, is much like this species, but apparently distinct from it.

Geryon quinquedens Smith.

Trans. Conn. Acad., V. p. 35, Pl. IX. figs. 1–1 *b*, 2, 1879; Proc. National Mus. Washington, III. p. 417, 1881.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
325	33° 35′ 20″	76° 0′ 0″	647	1 ♂
332	35° 45′ 30″	74° 48′ 0″	263	2 ♂
334	38° 20′ 30″	73° 26′ 40″	395	2 ♂
337	38° 20′ 8″	73° 23′ 20″	740	Fragments only.
343	39° 45′ 40″	70° 55′ 0″	732	3 ♀ with eggs.
309	40° 11′ 40″	68° 22′ 0″	304	1 ♂, 1 ♀ "
312	39° 50′ 45″	70° 11′ 0″	466	1 ♂

These specimens and others recently obtained by the U. S. Fish Commission show that this species grows to be one of the largest of the Brachyura. The very large individuals differ considerably from the specimens originally described. In all the large specimens the teeth of the antero-lateral margin of the carapax become reduced to angular tubercles, and in some of the larger ones the fourth tooth becomes entirely obsolete. Thus in specimens No. 2, 3, 5, 7, and 8 of the table of measurements given below, the fourth tooth is distinct; in No. 9, distinct, but very obtuse; in No. 4, distinct, but the right side of the carapax deformed by some injury; in No. 1, nearly obsolete; while in Nos. 6 and 10 it is entirely obsolete.

Ten specimens give the following measurements: —

No.	Station.	Sex.	Length of Carapax.	Breadth including spines.		Breadth excluding spines.	
1	312	♂	41.0 mm.	51.6 mm.	= 1.26 lgth.	45 mm.	= 1.10 lgth.
2	309	"	54.0	65.5	1.21	61	1.13
3	334	"	81.0	97.0	1.20	89	1.10
4	"	"	94.0	113.0	1.20	104	1.11
5	332	"	116.0	136.5	1.18	128	1.10
6	"	"	130.0	152.5	1.17	144	1.11
7	309	♀	47.5	61.0	1.28	55	1.16
8	343	"	82.5	99.5	1.21	92	1.12
9	"	"	84.0	100.0	1.19	91	1.18
10	"	"	92.0	107.5	1.17	101	1.10

In four of the above specimens the greatest expanse of the ambulatory legs, which is at next to the last pair, is as follows. No. 5, 540 mm.; No. 6, 625 mm. (24.6 inches); No. 8, 380 mm.; No. 10, 417 mm. The chelæ are almost exactly alike on the two sides, and in the largest male and largest female give the following measurements: —

	Right Chela.			Left Chela.		
	Length.	Height.	Length of Dactylus.	Length.	Height.	Length of Dactylus.
No. 6	114 mm.	42	62	112	38	62
" 10	68	25	39	68	23	38

OXYSTOMATA.

CALAPPIDÆ.

Acanthocarpus Alexandri Stimpson.

Stimpson, Bull. Mus. Comp. Zoöl., II. p. 153, 1870.
A. M.-Edwards, Ibid., VIII. p. 19, Pl. I. fig. 2, 1880.
Smith, Proc. National. Mus., Washington, III. p. 418, 1881.

Station 345, N.Lat. 40° 10′ 15″, W. Long. 71° 4′ 30″, 71 fathoms. A single male recently moulted and very soft, the carapax about 36.0 mm. long and 36.1 broad. It has also been taken at several stations off Martha's Vineyard by the U. S. Fish Commission in 1880 and 1881, and in living specimens from these stations the dorsal surface of the carapax and chelipeds was pale reddish orange, deepest in color upon the elevations of the carapax and upon the bases of the carpal spines of the chelipeds; while the carapax beneath, the sternum, abdomen, and the under surfaces of the chelipeds and ambulatory legs are white, very slightly tinged with reddish.

DORIPPIDÆ.

Cyclodorippe nitida A. M.-Edwards.

Bull. Mus. Comp. Zoöl., VIII. p. 24, 1880.

Plate II. Figs. 1-1b.

Station 319, N. Lat. 32° 25′, W. Long. 77° 42′ 30″, 262 fath. One specimen, which gives the following measurements: —

Station	319
Sex	♀
Length of carapax to middle of front	6.1 mm.
" " including frontal teeth	6.4
Breadth between tips of lateral teeth	6.9
Greatest breadth back of lateral teeth	6.9
Length of cheliped	10.0

Length of chela	5.0mm.
Breadth of "	1.7
Length of its dactylus	2.8
" first ambulatory leg	9.0
" dactylus	2.0
" second ambulatory leg	11.6
" dactylus	3.2
" telson	2.5
Breadth of "	4.8

ANOMURA.

LITHODIDEA.

Lithodes Agassizii, sp. nov.

Plate I.

This species is allied to *L. maia* and *L. antarctica* in having no scale and only a single spine at the base of the antenna, and in the general form and armament of the carapax and appendages, but differs from them both conspicuously in the rostrum, which is rather short and tridentate, with the lateral spines nearly as long as the rostral spine itself. The spines upon the carapax and appendages are more numerous and much more acute than in *L. maia*, and the marginal spines of the carapax are not very much larger than the dorsal. There are only two adults, both females, in the collection, and these differ remarkably from each other, and from three very young specimens, in the number and length of the spines upon the carapax and legs.

In the larger specimen the carapax, excluding the rostrum and spines, is about nine tenths as broad as long, with a conspicuous sinus in the middle of the posterior margin. The rostrum is very short, with an acute central spine scarcely as long as the eye-stalks and with a somewhat shorter lateral spine arising either side its base and directed upward and outward. The gastric region is swollen and very high, separated from the cardiac by a very deep depression, and armed with a pair of small spines just back of the lateral spines of the rostrum, and back of these on the highest part of the region with two widely separated pairs of much larger spines, while either side there is a small spine opposite the large hepatic spine, between which and the obtusely spiniform external angle of the orbit there are two spinigerous angular prominences in the antero-lateral margin. There is a distinct notch in the antero-lateral margin at the cervical suture, but back of this the margin is regularly arcuate to the middle of the posterior margin, and is armed with about thirteen stout spines, of which the larger are about as large as the hepatic spines. The branchial region is considerably convex, and armed, in addition to those upon the margin, with about ten large spines, between which there are a consider-

able number of low obtuse spines or tubercles. The cardiac region is separated from the branchial each side by a deep sulcus, is prominent and armed with two pairs of large spines, and back of these with a single one in the middle line.

The eyes, antennulæ, antennæ, and the exposed parts of the oral appendages are very nearly as in *L. maia*. The chelipeds are nearly equal in length, but the right is much stouter than the left, are armed with comparatively few and small spines, and the digits of the chelæ are about two thirds of the entire length of the chela, slender, tapering, and strongly curved. The ambulatory legs are very long, those of the third pair being nearly three times as long as the breadth of the carapax excluding spines. The ischial, meral, and carpal segments are armed with only a very few scattered and very small spines, the meral segments in the first and second pairs are almost entirely unarmed except a few small spines or teeth along the upper edges, but the propodi, which are slender and fully as long as the corresponding meri, are armed along the edges with more numerous and very sharp but small spines. The dactyli are about half to considerably more than half the length of the corresponding propodi, slightly curved, acute, and, except near the tips, armed with small and acute spines.

The plates of the second somite of the abdomen are armed with numerous spines projecting backward and upward, and of which those upon the middle plate are longer than those upon the lateral. The plates of the succeeding somites of the abdomen are very unequally developed, the plates of the left hand side of the third, fourth, and fifth somites being greatly developed at the expense of the corresponding plates of the opposite side, so that the outer edge of the left side of the fifth segment lies beneath the bases of the cheliped and first ambulatory leg of the right side, and the small semicircular telson is beneath, or a very little in front of the base of the second ambulatory leg of the right side.

In the smaller of the adult specimens (Pl. I. fig. 1) the carapax, excluding rostrum and spines, is proportionally narrower than in the larger specimen, being about eight tenths as broad as long, and the spines upon the carapax, abdomen, and appendages are much longer and more numerous, the additional spines appearing between the large ones corresponding to the spines, or in place of the tubercles, on the larger specimen. The rostral spine and the spines at its base are absolutely more than twice as long as in the larger specimen and more slender, and about the same proportion holds for all the principal spines of the carapax. The external angle of the orbit projects in a spine but little shorter than the eye-stalk, and back of it there are two nearly as large spines on the antero-lateral margin in place of the two angular prominences of the larger specimen. The large hepatic spine and the thirteen large marginal spines back of the cervical suture are most of them but little smaller than the rostral spine, are directed more upward than outward, and there are nearly as many more additional smaller spines alternating with the larger. There is a conspicuous additional spine in the middle of the gastric region, and numerous additional small spines on other parts of the carapax.

The chelipeds and ambulatory legs have about the same proportions as in the larger specimen, but are armed with very numerous acute spines, many of which are of large size. The spines upon the second somite of the abdomen are more numerous, and the larger ones much longer and more slender than in the larger specimen.

The small specimens are all immature, with the carapax excluding the rostrum and spines less than 13 mm. in length, and differ so much from the adults that they might readily be mistaken for a distinct species. These small specimens differ considerably in size, but are all essentially alike. The smallest and most perfect one is from the U. S. Fish Commission dredgings off Martha's Vineyard. In this specimen (Pl. I. figs. 2, 2ª) the carapax excluding the rostrum and spines is only 12.6 mm. in length and scarcely more than seven tenths as broad as long, but all three of the rostral spines and several spines of the carapax proper are more than half as long as the carapax. The spines are much fewer in number than in either of the adult specimens, very slender and acute, and those at the base of the rostrum are just about as large as the rostrum itself. The gastric region is proportionally very much larger than in the adults, but is high and separated from the cardiac region by a deep sulcus, as in them, and is armed with six slender spines, — two pairs on the highest part of the region, of which the anterior pair are almost as long as the rostrum, but the posterior considerably shorter, and a still smaller lateral spine each side. There are two pairs of slender spines on the anterior part of the cardiac region, the anterior a little longer and the posterior a little shorter than the posterior gastric spines. The single hepatic spine each side is nearly as long as the rostrum. The external angle of the orbit projects forward in a long and slender spine, back of which are two smaller spines on the antero-lateral margin. There are about twelve slender spines on the lateral and posterior margin back of the cervical suture each side, but they are all small compared with the other spines of the carapax and about half of them are inconspicuous, and above these on either branchial region there are six much larger spines, of which two near the middle of the region are as long as the posterior gastric, but the others considerably shorter.

The eye-stalks and eyes are small and proportionally but little larger than in the adult, but there are two or three sharp spines projecting in front over the eye in place of some inconspicuous tubercles in the adults. The antennulæ, antennæ, and the exposed parts of the oral appendages, are nearly as in the adults.

The chelipeds are nearly as unequal as in the adults, and are armed with very much longer and more slender spines, several of those upon the distal part of the merus and upon the carpus being longer than the carpus itself. The ambulatory legs have about the same proportions as in the adults, but the spines with which they are armed are fully as long as those upon the chelipeds, the longer ones, as in the chelipeds, being upon the distal parts of the meri and upon the carpi.

The abdomen is *symmetrical*. The second somite is made up of three calci-

fied and spiny plates, nearly as in the adult female. The third, fourth, and fifth somites are soft, scarcely at all calcified, and show no distinct division into somites. The sixth is small and sunken for its whole length in the proximal somites, while the seventh is still smaller and rounded at the extremity.

Four of the five specimens seen give the following measurements: —

Station	1029	305	329	326
Sex	Young.	Young.	♀	♀
Length of carapax including rostrum and posterior spines	17.5	25+	115	139
Length of carapax excluding rostrum and posterior spines	9.1	12.6	90	123
Breadth of carapax between tips of hepatic spines,	13.5	18+	57	64
" " " " " branchial spines,	13.0	18+	87	117
Greatest breadth of carapax excluding spines	6.6	9.0	77	110
Length of rostrum	7.3	9+	17	8
" spines at base of rostrum	7.4	11.5	16	7
" anterior gastric spines	7.0	10.5	12	5
" " cardiac	6.3	8.0	10	5
" right cheliped	15.0	19.0	126	171
" " chela	6.1	8.5	55	66
Breadth of " "	1.9	2.5	18	25
Length of dactylus of right chela	3.5	5.0	35	44
" left cheliped	15.0	20.0	126	167
" " chela	6.0	8.8	50	62
Breadth of "	1.5	1.9	14	19
Length of dactylus of left chela	3.8	5.5	36	44+
" first ambulatory leg	18.5	30.0	220	270
" second " "	19.5	31.5	245	310
" third " "	19.5	32.0	260	320
Greatest expanse of ambulatory legs	43.0	65.0	560	720

Station.	N. Lat.	W. Long.	Fathoms.
305	41° 33′ 15″	65° 51′ 25″	810
326	33° 42′ 15″	76° 0′ 50″	464
329	34° 39′ 40″	75° 14′ 40″	603

Also taken by the U. S. Fish Commission, off Martha's Vineyard, in 1881, Stations 1028 and 1029, 410 and 458 fathoms; one young specimen in each case.

PAGURIDEA.

PAGURIDÆ.

Eupagurus Kröyeri Stimpson.

Eupagurus Kröyeri Stimpson, Ann. Lyceum Nat. Hist. New York, VII. p. 89 (43), 1859.

Smith, Trans. Conn. Acad., III. p. 28, 1874; Ibid., V. p. 48; Proc. National Mus., Washington, III. p. 428, 1881.

Eupagurus pubescens Kröyer, in Gaimard, Voyages en Scandinavie, Pl. II. fig. 1, 1849 (*non* Kröyer, Naturh. Tidssk., II. p. 251, 1839).

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
303	41° 34′ 30″	65° 54′ 30″	306	6
306	41° 32′ 50″	65° 55′ 0″	524	4
311	39° 59′ 30″	70° 12′ 0″	143	2 in *Epizoanthus*.

Nearly all the specimens I have seen from deep water off the Southern coast of New England are small, and the great majority of them were inhabiting carcinœcia overgrown by or composed of *Epizoanthus Americanus* Verrill.

Eupagurus politus, sp. nov.

Plate II. Fig. 5.

The carapax is not suddenly narrowed at the bases of the antennæ, where the breadth is equal to the length in front of the cervical suture, and not rostrated, the median lobe of the front being broadly rounded and not projecting as far forward as the external angles of the orbital sinuses, which are acute and each usually armed with a short spine.

The eye-stalks, including the eyes, are nearly four fifths as long as the breadth of the carapax in front, stout, and expanded at the very large black eyes, which are terminal, not oblique, compressed vertically, and broader than half the length of the stalks. The ophthalmic scales are small, narrow, and spiniform at the tips.

The peduncle of the antenna is about as long as the breadth of the carapax in front, and the ultimate segment about a third longer than the penultimate. The upper flagellum is much longer than the ultimate segment of the peduncle, while the lower is only about half as long as the upper, slender, and composed of ten to twelve segments. The peduncle of the antenna reaches slightly beyond the eye. The acicle is slender, slightly curved, and reaches to the tip of the peduncle, and inside its base there is a minute tooth, while outside there is a straight spine toothed or spined along its inner edge, acute at the tip and half as long as the acicle itself. The flagellum is nearly naked, and about three times as long as the carapax.

The exposed parts of the oral appendages are very nearly as in *E. bernhardus*.

The chelipeds are longer, much narrower, and more nearly equal in size than in *E. bernhardus*, and, as in that species, are almost entirely naked, but beset with numerous tubercles and low spines. The right cheliped is about as long as the body from the front of the carapax to the tip of the abdomen. The merus and carpus are subequal in length, while the chela is about once and a half as long as the carpus. The carpus and chela are rounded above and armed with numerous tubercles, which are smaller and more crowded on the chela than on the carpus, but the surface between the tubercles is smooth and polished. The dorsal surface of the carpus is limited along the inner edge by a sharp angle armed with a double line of tubercles, while the outer edge is rounded. The chela is very little wider than the carpus, and is narrowed from near the base to the tips of the digits, and both edges are rounded. The digits are rather slender, about half as long as the entire chela, slightly gaping, with acute and strongly incurved chitinous tips, and the prehensile edges armed with a very few obtuse tuberculiform teeth. The left chela is much more slender than the right, but reaches to or a little by the base of its dactylus. The carpus is slender, higher than broad, only slightly expanded distally, and with the narrow dorsal surface flattened and margined either side with a single line of spiniform tubercles. The chela is about a third longer than the carpus, slender, about two and a half times as long as broad, and the dactylus about two thirds the entire length. The dorsal and outer surface is tuberculose, and a low obtuse ridge extends from near the middle of the base along the propodal digit, which tapers from the base to the tip, while the dactylus is smooth except for a few fascicles of setæ, more slender than the propodal digit, and tapered only near the tip. The chitinous tips of the digits are slender, acute, and strongly incurved, and the prehensile edges are sharp, and armed with a closely set series of slender spines or setæ.

The ambulatory legs reach considerably beyond the right cheliped, and the second pair reach to the tips of the first pair. In both pairs the meri and propodi are approximately equal in length and longer than the carpi, while the dactyli are about once and a half as long as the propodi, slender, strongly curved, and distally strongly twisted. The two posterior pairs of thoracic legs and the abdominal appendages are very nearly as in *E. bernhardus*.

In life the general color of the exposed parts is pale orange, the tips of the chelæ and of the ambulatory legs white, the eyes black.

The eggs are very large, and few in number as compared with the ordinary species of the genus, being 1.0 to 1.1 mm. in diameter in alcoholic specimens, while in *E. bernhardus* they are only 0.45 to 0.50 mm. in diameter.

Three specimens give the following measurements : —

Station	306	309	309
Sex	♀	♂	♂
Length from front of carapax to tip of abdomen	25.0 mm.	40.0 mm.	50.0 mm.
" of carapax along median line	10.0	16.0	21.0

Breadth of carapax in front	5.5 mm.	8.6 mm.	11.0 mm.
Length of eye-stalks	4.7	6.2	7.8
Greatest diameter of eye	2.7	3.5	4.1
Length of right cheliped	30.0	40.0	56.0
" carpus	7.3	11.3	14.5
" chela	12.0	16.0	22.7
Breadth of chela	5.8	8.3	11.0
Length of dactylus	6.1	9.1	11.9
" left cheliped	25.0	37.0	48.0
" carpus	6.1	10.0	12.0
" chela	9.2	13.5	17.5
Breadth of chela	4.0	5.8	7.5
Length of dactylus	5.8	8.8	11.2
" first ambulatory leg, right side	36.0		67.0
" propodus	7.6		14.5
" dactylus	11.5		22.0
" second ambulatory leg, right side	38.0	54.0	73.0
" propodus	8.8	12.0	16.0
" dactylus	13.0	17.0	23.0

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
309	40° 11′ 40″	68° 22′ 0″	304	3
310	39° 59′ 16″	70° 18′ 30″	260	2
336	38° 21′ 50″	73° 32′ 0″	197	5

It has also been taken, and in great abundance, by the U. S. Fish Commission, off Martha's Vineyard and off the Capes of the Delaware, in 65 to 365 fathoms, and is the species which I have referred to, in Proc. National Mus., Washington, III. p. 428, 1881, as "*Eupagurus*, sp."

CATAPAGURUS A. M.-Edwards.

Catapagurus A. M.-Edwards, Bull. Mus. Comp. Zoöl., VIII. p. 46, 1880 (Dec. 29).
Hemipagurus Smith, Ann. Mag. Nat. Hist., 5th ser., VII. p. 143, Feb. 1881; Proc. National Mus., Washington, III. p. 422, 1881.

I have no doubt that my genus is synonymous with that of Milne-Edwards as indicated above, but I am quite unable to tell from the description alone whether one of my species is synonymous with the single species, *C. Sharreri*, described by Milne-Edwards. *C. Sharreri* agrees more nearly in size with *H. socialis* than *H. gracilis*, but will very likely prove to be distinct from either, and until this can be determined satisfactorily, it seems best to refer both my species to *Catapagurus*.

The genus differs from *Spiropagurus* Stimpson in the form and position of the sexual appendage (formed by the permanent extrusion of a portion of the

vas deferens) of the last thoracic somite of the male, which arises from the *right* coxa, and is curved in one plane round the right side of the abdomen; while in *Spiropagurus* the appendage arises from the *left* coxa, and is spirally curved.

The carapax is short and broad, and the anterior margin is obtuse, and does not wholly cover the ophthalmic somite between the eyes. The portion in front of the cervical suture is indurated, but all the rest of the carapax is very soft and membranaceous, without any distinct induration along the cardiacobranchial suture. The ophthalmic scales are well developed. The eye-stalks are short and the cornea expanded. The antennulæ, antennæ, and oral appendages are similar to those in *Eupagurus;* the exopods of all the maxillipeds are, however, proportionally much longer than in that genus. There are eleven pairs of phyllobranchiæ, arranged as in *Eupagurus bernhardus*, but the two anterior pairs connected with the external maxillipeds are very small, and composed of a few flattened papillæ. The chelipeds are slender and unequal. The first and second pairs of ambulatory legs are long, and have slender, compressed, and ciliated or setigerous dactyli; the third pair are only imperfectly subcheliform.

In the male, the second, third, and fourth somites of the abdomen bear small appendages upon the left side, as in most of the allied genera, but the fifth somite is destitute of an appendage; in the female, the appendages of the second, third, and fourth somites are biramous and ovigerous, and there is usually a rudimentary uniramous appendage upon the fifth somite, as in the allied genera.* The uropods are very nearly or quite symmetrical, the rami of the right appendage being very nearly or quite as large as that of the left. The telson is bilobed at the extremity.

As might be expected, the unsymmetrical development of the external sexual appendages of the males of the two species here described corresponds to a like unsymmetrical development of the internal sexual organs, and the following incomplete observations, made on ordinary alcoholic specimens in which the abdominal viscera are not sufficiently well preserved for a full anatomical or histological investigation, appear of sufficient importance to notice here, especially as nothing appears to be known of the internal structure of either species of *Spiropagurus*.

The right testis and vas deferens are much larger than the left. The lower part of the right vas deferens, in all the adults examined, is much more dilated than the left, and is filled (as is also the external part of the duct) with very large spermatophores of peculiar form. The left vas deferens is slender, much as in *Eupagurus bernhardus*, terminates in a small opening in the left coxa of the last thoracic somite, as in ordinary Paguroids, and contains spermatophores somewhat similar in form and size to those of *Eupagurus bernhardus*. In alco-

* In many of the best preserved and most perfect females of *C. socialis* examined I can find no trace whatever of this appendage of the fifth somite, while in others it is very easily seen.

holic specimens of *C. socialis* the spermatophores from the left vas deferens are approximately 0.16 mm. long and 0.035 mm. broad, with a slender neck about a third of the entire length, and a very thin and delicate lamella for a base. The spermatophores from the right vas deferens are over 2 mm. in total length ; the body itself is oval, approximately 0.40 mm. long and a third as broad ; at one end it terminates in a very long and slender process, two or three times as long as the body ; at the other end there is a similar but slightly stouter process, a little longer than the body, and expanding at its tip into a broad and very delicate lamella, approximately 0.35 mm. long by 0.20 mm. broad.

Catapagurus socialis.

Hemipagurus socialis SMITH, Proc. National Mus., Washington, III. p. 423, 1881.

Male. — The part of the carapax in front of the cervical suture is about a fifth broader than long, with the sides nearly parallel ; the front margin sinuous, curving slightly forward in the middle and each side between the eye-stalks and the peduncles of the antennæ, the middle lobe thus formed being scarcely more prominent than the lateral lobes, each of which is armed with a minute spine, projecting forward just inside of the peduncle of the antenna ; between these spines the edge of the front is upturned in a sharp marginal carina, which terminates each side in the spines themselves. The dorsal surface of this part of the carapax is convex in both directions, the protogastric lobes are protuberant and well marked, and nearly the whole surface is roughened and more or less tuberculose, with transverse scabrous elevations, which give rise to numerous hairs. The branchial regions are slightly swollen, so that the breadth of the carapax posteriorly is greater than in front. All the portions back of the cervical suture are smooth and membranaceous.

The eye-stalks are about half as long as the carapax in front of the cervical suture, flattened and expanded distally, where they are about three fourths as broad as long. The eye itself is black, and the cornea extends round either side so as to be crescent-shaped as seen from above. The ophthalmic scales are less than half as long as the eye-stalks, narrow, triangular, and acute.

The first and second segments of the peduncle of the antennula are subequal in length, and the ultimate segment nearly once and a half as long as the penultimate, and almost as long as the eye-stalks. The superior or major flagellum is nearly as long as the ultimate segment of the peduncle ; the thick, ciliated basal portion consists of about fourteen segments, and the slender terminal portion, which is nearly once and a half as long as the basal, of about five very slender and subequal segments. The minor flagellum is about two thirds as long as the major, and composed of about eight segments. The peduncle of the antenna reaches by the eye nearly the length of the last segment, which is about as long as the greatest diameter of the eye. The acicle is slender, acute, and slightly longer than the last segment of the peduncle. The flagellum reaches beyond the tips of the ambulatory legs.

The chelipeds are slender and very nearly equal in length, but the right is very much stouter than the left. In the right cheliped the merus and carpus are subequal in length, together nearly twice as long as the carapax, and both are rough and obscurely spinous, the spines being most conspicuous on the edges of the upper surface of the carpus, which is fully three times as long as broad, flattened above, and angular, but not distinctly carinated along either side. The chela is not far from twice as long as the carpus, nearly three times as long as broad, compressed vertically, evenly rounded, smooth and nearly naked above, but clothed with long, soft hair beneath; the digits are longitudinal, not gaping, and the dactylus is about two thirds as long as the basal portion of the propodus, and its prehensile edge is armed with a broad tooth near the middle. In the left cheliped the merus and carpus are similar to those of the right, but much more slender and a little longer; the carpus is about six times as long as broad, and the edges of the upper surface are rather more sharply angular than in the right; the chela is shorter than the right, but very slender, smooth, and nearly naked; the digits are similar, longitudinal, slightly longer than the basal portion of the chela, compressed, slightly curved downward toward the tips, but the prehensile edges straight and very minutely serrate.

The ambulatory legs are very nearly equal in length, and slightly overreach the chelipeds; the merus is about as long as the left chela, and roughened with small spines on the upper and under edges; the propodus is shorter than the merus, compressed, smooth, and ciliated along the edges; the dactylus is a little longer in the second than in the first pair, but in both shorter than the propodus, very strongly compressed, very slightly twisted, about ten times as long as broad, and thickly ciliated along both edges, except for a short distance along the lower edge near the tip.

The *female* is smaller than the male, and has proportionally shorter ambulatory legs, and chelipeds very much shorter and much more alike. The right chela is only about a third longer than the carpus, little more than a third as broad as long, and the digits are slender and nearly as long as the basal portion. The left cheliped is proportionally stouter than in the male, and thus approximates to the right; the chela itself is scarcely more than a third longer than the carpus. The ambulatory legs overreach the chelipeds by nearly or quite the full length of the dactyli, but all the segments have very nearly the same relative proportions as in the male.

The eggs are few in number and very large, being about a millimeter in diameter in alcoholic specimens.

In young males the chelipeds and ambulatory legs are similar to those of the female.

Two specimens from Station 314 give the following measurements: —

Sex	♂	♀
Length from front of carapax to tip of abdomen	18.0 mm.	15.0 mm.
" of eye-stalks	2.8	2.5

Greatest diameter of eye	2.0 mm.	1.6 mm.
Length of right cheliped	30.0	15.0
" chela	11.5	5.2
Breadth of propodus	4.4	1.9
Length of left cheliped	26.0	14.5
" chela	9.5	5.0
Breadth of propodus	2.0	1.2
Length of first ambulatory leg, right side	32.0	19.5

The carcinœcium is very rarely a naked gastropod shell; in most of the specimens seen it is either built up by a colony of *Epizoanthus Americanus*, or is made up in a somewhat similar way by the single polyp of *Adamsia sociabilis* Verrill, the base secreted by the *Adamsia* being expanded on either side and united below so as to enclose the crab in a broadly conical cavity, with only a slight spiral curvature. The nuclei about which these polypean carcinœcia are formed are of various origins; the majority of the *Adamsia* carcinœcia appear to have been built upon fragments of pteropod shells, in some cases upon bits of worm-tubes, in one case upon the entire shell of a *Cadulus*, the greater part of the shell being left protruding from the base of the polyp. In the carcinœcia formed by *Epizoanthus* the nucleus seems usually to have been absorbed, so that nothing is left distinguishable from the colony of polyps itself. In some cases the *Adamsia* has completely overgrown a small *Epizoanthus* carcinœcium, so that when the *Adamsia* is removed a perfect *Epizoanthus* carcinœcium is found beneath as a nucleus. The carcinœcium of this species, and of *C. gracilis* as well, does not cover the animal to the same extent as is usual in the species of *Eupagurus*, the anterior part of the carapax being apparently constantly exposed, and its induration fitting the animal for such exposure. The *Epizoanthus* carcinœcia are, however, very often disproportionately large for the crabs inhabiting them, having grown out either side until they are several times broader than long. In spite of these often enormous carcinœcia, both species of the genus probably swim about by means of the ciliated dactyli of the ambulatory legs, as *Spiropagurus spiriger* has been observed to do by Stimpson (Proc. Acad. Nat. Sci. Philadelphia, 1858, p. 248 (86), 1859).

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
311	39° 59′ 30″	70° 12′ 0″	143	6
313	32° 31′ 50″	78° 45′ 0″	75	2
314	32° 24′ 0″	78° 44′ 0″	142	1000±
315	32° 18′ 20″	78° 43′ 0″	225	4
316	32° 7′ 0″	78° 37′ 30″	229	1
327	34° 0′ 30″	76° 10′ 30″	178	8
344	40° 1′ 0″	70° 58′ 0″	129	40±
345	40° 10′ 15″	71° 4′ 30″	71	5

This species was taken in great abundance, in 51 to 250 fathoms, off Martha's Vineyard, by the U. S. Fish Commission, in 1880 and 1881.

Catapagurus gracilis.

Hemipagurus gracilis SMITH, Proc. National Mus., Washington, III. p. 426, 1881.

This is a smaller and more slender species than the last, and is readily distinguished from it by the smooth carapax, the longer and more slender eye-stalks, the long and acicular ophthalmic scales, and by the narrow dactyli of the ambulatory legs being longer than the corresponding propodi.

Male. — The carapax in front of the cervical suture is flat, smooth, nearly naked, and scarcely at all areolated. The anterior margin is rather more strongly sinuous than in *C. socialis*, and the lateral lobes are slightly angular and each is tipped with a minute spine, as in that species, but the marginal carina between these spines is much less distinct.

The eye-stalks are more than half as long as the carapax in front of the cervical suture, flattened and expanded distally, but only about half as broad as long. The eyes themselves are as in *C. socialis*. The ophthalmic scales are more than half as long as the eye-stalks, and are acicular and regularly acute.

The ultimate segment of the peduncle of the antennula is as long as the eye-stalk and nearly twice as long as the penultimate segment. The major flagellum is as long as the ultimate segment of the peduncle, the basal portion of about eight segments, the terminal portion three times as long and of about five subequal and very slender segments. The minor flagellum is about half as long as the major, and composed of about six segments. The antennæ are very much as in *C. socialis*.

The chelipeds are nearly equal in length and similar to those of *C. socialis*, but in the right cheliped the inner edge of the upper surface of the carpus is angular, and armed with a regular series of twelve to eighteen small spines, while the outer edge is rounded and unarmed ; and the prehensile edge of the dactylus is armed with two irregular and indistinct teeth, corresponding with two irregular emarginations in the edge of the digital portion of the propodus. In the left cheliped the outer edge of the upper surface of the carpus is slightly rounded and scarcely at all spinulous, while the inner edge is armed as in the right cheliped. The left chela differs from that of *C. socialis*, in having the digital portion of the propodus considerably stouter than the dactylus, particularly toward the base.

The ambulatory legs are proportionally as long as in *C. socialis*, but more slender ; in both pairs the dactylus is longer than the propodus, curved slightly near the tip, about sixteen times as long as broad, sparsely ciliated along the upper edge, and very slightly setigerous along the lower.

The *female* differs from the male as in *C. socialis*, but to a very much less extent, the chelipeds and ambulatory legs being only a little shorter than in the male, and the right cheliped only a little less stout and a little more like the left than in the male.

The eggs are few and nearly as large as in *C. socialis*.

The carcinœcia are similar to those of the last species.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
344	40° 1′ 0″	70° 58′ 0″	129	1
345	40° 10′ 15″	71° 4′ 30″	71	3

Also taken by the U. S. Fish Commission, in 51 to 155 fathoms, off Martha's Vineyard, in 1880 and 1881.

Two specimens from Fish Commission Station 874, 85 fathoms, give the following measurements : —

Sex	♂	♀
Length, from front of carapax to tip of abdomen	12.0 mm.	11.2 mm.
Length of eye-stalk	1.6	1.5
Greatest diameter of eye	1.1	0.9
Length of right cheliped	15.2	11.2
" chela	6.0	4.4
Breadth of chela	2.4	1.8
Length of left cheliped	13.6	10.0
" chela	5.0	3.6
Breadth of chela	1.1	1.0
Length of first ambulatory leg, right side	16.1	12.8

PARAPAGURIDÆ.

The genus *Parapagurus* differs so widely from all other Paguridea in possessing trichobranchiæ instead of phyllobranchiæ, that it ought, undoubtedly, to be separated as a distinct family on this character alone.

Parapagurus pilosimanus Smith.*

Trans. Conn. Acad., V. p. 51, 1879 ; Proc. National Mus., Washington, III. p. 428, 1881.

Plate II. Figs. 4 - 4[1].

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
306	41° 32′ 50″	65° 55′ 0″	524	1 young.
309	40° 11′ 40″	68° 22′ 0″	304	4
322	33° 10′ 0″	76° 32′ 15″	362	2 ♂

This species has also been taken, and in considerable abundance, by the U. S. Fish Commission, in deep water off Martha's Vineyard. At Station

* A. Milne-Edwards in a recent report on the explorations of the "Travailleur," in the Comptes-Rendus of the Academy of Sciences, Paris, Dec. 1881 (Ann. Mag. Nat. Hist., 5th ser., IX. p. 42, 1882), states that his *Eupagurus Jacobii* from the "Blake" dredgings (Bull. Mus. Comp. Zoöl., VIII. p. 42, 1880) is identical with this species, of which specimens were sent to him last June.

947, 312 fathoms, three hundred and ninety-three specimens, nearly all adults and many of them very large, were taken at one haul of the trawl.

The carcinœcia of all the specimens seen are formed by colonies of *Epizoanthus paguriphilus* Verrill, which at first invest spiral shells which are finally absorbed by the basal cœnenchyma of the growing polyps.

GALATHEIDÆ.

Galacantha rostrata A. M.-Edwards.

Bull. Mus. Comp. Zoöl., VIII. p. 52, 1880.

Plate IX. Figs. 2, 2ª.

Station 340, N. Lat. 39° 25′ 30″, W. Long. 70° 58′ 40″, 1394 fathoms; and Station 341, N. Lat. 39° 38′ 20″, W. Long. 70° 56′, 1241 fathoms; two males, which give the following measurements: —

Station	341	340
Sex	♂	♂
Length from tip of rostrum to tip of telson	75.0 mm.	62.0 mm.
" of carapax to bases of rostral spines	34.5	28.8
Greatest breadth excluding spines	27.0	23.2
" " including "	31.5	26.7
Length of rostrum above its lateral spines	7.8	8.0
" gastric spine	7.7	7.8
Greatest breadth of abdomen, third somite	24.2	24.0
" diameter of eye	3.0	2.4
Length of cheliped	53.5	44.0
" chela	21.5	16.7
" dactylus	13.0	10.3
" first ambulatory leg	65.0	53.0
" posterior leg	39.0	31.0

MUNIDOPSIS Whiteaves.

Munidopsis Whiteaves, Amer. Jour. Sci., 3d ser., VII. p. 212, 1874.
Galathodes A. M.-Edwards, Bull. Mus. Comp. Zoöl., VIII. p. 53, 1880.

Munidopsis curvirostra Whiteaves.

Amer. Jour. Sci., 3d. ser., VII. p. 212, 1874; Report on further Deep-sea Dredging Operations in the Gulf of St. Lawrence [in 1873], p. 17, 1874.

Plate VIII. Figs. 2, 3, 3ª.

Station 325, N. Lat. 33° 35′ 20″, W. Long. 76°, 647 fathoms, one small male, which gives the following measurements: —

Length from tip of rostrum to tip of telson	16.0 mm.
" of carapax	10.4
Greatest breadth of carapax	5.2
Diameter of eye	0.8
Length of cheliped	15.0
" chela	5.9

I have compared this specimen with the original specimens from the Gulf of St. Lawrence described by Whiteaves, and find no differences of any importance whatever. The species is perhaps identical with some one of the ten species of *Galathodes* described by Milne-Edwards, but with which, if with any, it seems impossible to determine from the descriptions alone.

Munida, sp. indet.

Munida Caribœa ? SMITH, Proc. National Mus., Washington, III. p. 428, 1881.

Plate X. Fig. 1.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
311	39° 59′ 30″	70° 12′ 0″	143	1
314	32° 24′ 0″	78° 44′ 0″	142	50±
315	32° 18′ 20″	78° 43′ 0″	225	1
333	35° 45′ 25″	74° 50′ 30″	65	100±
335	38° 22′ 25″	73° 33′ 40″	89	31
336	38° 21′ 50″	73° 32′ 0″	197	6
344	40° 1′ 0″	70° 58′ 0″	129	1

Also taken in great abundance in the U. S. Fish Commission dredgings off Martha's Vineyard, in 1880 and 1881, in 65 to 200 fathoms.

This species will probably prove identical with one of the eleven species enumerated by A. Milne-Edwards in his report on the "Blake" crustacea from the West Indies, but with which one it is not possible to tell from the descriptions alone. Before the publication of Milne-Edwards's report I referred this species doubtfully, as indicated above, to *Munida Caribœa* of Stimpson, described from a single very small specimen, but it is probably not the species referred to the *Caribœa* by Milne-Edwards. It is now impossible to tell with certainty to which of the numerous Caribbean species Stimpson's really belongs, but it is perhaps best to restrict it to the one called *Caribœa* by Milne-Edwards, whatever that may be, although he gives no description whatever.

MACRURA.

ERYONTIDÆ.

Pentacheles sculptus.

Plates III. and IV.

Polycheles sculptus SMITH, Ann. Mag. Nat. Hist., London, 5th ser., V. p. 269, April, 1880; Proc. National Mus., Washington, II., 1879, p. 345, Pl. VII., 1880.

Pentacheles spinosus A. M.-EDWARDS, Bull. Mus. Comp. Zoöl., VIII. p. 66, December, 1880.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
325	33° 35′ 20″	76° 0′ 0″	647	1 young, 44 mm. long.
326	33° 24′ 15″	76° 0′ 50″	464	1 ♂, 2 ♀
329	34° 39′ 40″	75° 14′ 40″	603	2 ♂

This species was first described from a single imperfect specimen taken by a Gloucester fisherman, off the coast of Nova Scotia, N. Lat. 43° 10′, W. Long. 61° 20′, in 250 fathoms, so that the specimens recorded above, and a large female with eggs, taken, Nov. 16, 1880, off the mouth of Chesapeake Bay, N. Lat. 37° 24′, W. Long. 74° 17′, 300 fathoms, Station 898, by Lieut. Tanner, on the U. S. Fish Commission Steamer "Fish-Hawk," afford an opportunity for a more complete description than that originally given.

The sides of the carapax are nearly parallel posteriorly, but arcuately convergent anteriorly, and the greatest breadth is just in front of the cervical suture, and is about three fourths of the length along the median line. As seen from above, the anterior margin is concave in outline, so that the acute and spiniform lateral angles are much in advance of the rostrum, which is armed with two spines close together and projecting obliquely upward and forward. About a third of the space between the median line and the lateral angle each side is occupied by a very deep orbital sinus nearly parallel with the lateral margin, considerably deeper than broad, somewhat narrowed and evenly rounded posteriorly, and completely filled by the large ophthalmic lobe. On the inner side of this sinus the frontal margin projects in a small spiniform tooth, but outside the margin is unarmed and curves regularly to the lateral angle. Just behind the orbital sinus there is a smooth and evenly curved depression in the surface of the carapax exposing a small area on the posterior part of the ophthalmic lobe, more fully described beyond. The cervical suture divides the dorsal surface of the carapax into two pretty nearly equal portions, and is deep and conspicuous, but is indicated in the lateral margin, each side, by a slight emargination only, which is scarcely deeper than the emargination between the anterior and posterior lobes of the hepatic region. The lateral margin is armed, on the anterior lobe of the hepatic region, with (including the anterior angle) six, or rarely only five, small and slender spiniform teeth di-

rected forward, and on the posterior lobe with three more. The lateral margin, behind the cervical suture, is armed with six to eight similar teeth, which become successively more remote posteriorly. There is a slight median carina extending the whole length of the carapax, and armed, behind the two rostral spines, first with a single small spine directed forward, then with two side by side and very close together, then with one, then with two on the posterior edge of the cervical suture, then with two more, and finally with two somewhat larger and more widely separated spines projecting forward from the anterior edge of the broad and prominently raised posterior margin. In front of the cervical suture there is an irregular longitudinal dorso-lateral line of five minute spines each side, and back of these a single spine each side on the posterior edge of the cervical suture. Extending from the posterior margin nearly to the cervical suture, there is a sharp sublateral carina parallel to the lateral margin, about a third of the way from it to the median carina, and armed with five or six small spines.

The ventral regions of the carapax (Pl. IV. fig. 1) are inflected each side at a very acute angle with the dorsal surface, and, the sternum being narrow, the ventral regions are very broad. The ventral region each side is divided longitudinally into three approximately equal parts by two prominent carinæ; the outer carina (marking the pleurotergal suture?) extends from the anterior margin at the base of the antenna, in a slightly sinuous line, toward the postero-lateral margin of the carapax; the anterior half is very prominent, and armed with small spines directed outward, while the posterior half is much less conspicuous, unarmed, and disappears entirely before reaching the posterior angle of the carapax. The inner carina extends along the branchial region from near the base of the first leg quite to the postero-lateral angle of the carapax; the extreme anterior portion is not prominent, but from opposite the third leg posteriorly it is very prominent, acute, and armed with ten to fifteen sharp spines. The outer of the three longitudinal regions thus marked out is divided transversely by the cervical suture, and the anterior portion (subhepatic region) is divided transversely into an anterior and a posterior lobe by a groove nearly or quite as conspicuous as the cervical. In the frontal margin of this anterior lobe, and near its inner side, there is a deep sinus corresponding to the orbital sinus of the dorsal surface, but not quite as wide, and open nearly to the dorsal surface, except where it is crossed by a protuberance from the ventral portion of the ophthalmic lobe.

On the upper surface of the carapax, the orbital sinus, each side, is completely filled by the dorsal part of the ophthalmic lobe, of which the anterior margin is slightly concave in outline and continuous with the anterior margin of the carapax, but has a small tubercle near the middle. The dorsal surface of the lobe is smooth, calcareous, and opaque, and on a level with the adjacent surface of the carapax except posteriorly, where a small oval area of the extremity of the lobe is exposed by a depression in the carapax. This oval area is thin, semitranslucent, and not calcareous, and has every appearance of being a true corneal area, although I am unable to detect any evidence of facets. The

carapax along the margins of the sinus is in close contact with the ophthalmic lobe. From the lower portion of each ophthalmic lobe there is an elongated cylindrical and somewhat conical, but obtuse and pointed protuberance, of which the base rests in a transverse groove in the base of the antenna, while the terminal portion extends well across the open ventral side of the orbital sinus. Upon the obtuse extremity of this protuberance there is a nearly circular area similar to the cornea-like area at the posterior extremity of the dorsal part of the lobe.

The peduncles of the antennulæ are very stout, being stouter even than the peduncles of the antennæ. The basal portion of the proximal segment is longer than the two distal segments, is armed on the distal portion of the outer margin with two spiniform teeth, and the inner side is broadly expanded and prolonged into an acute scalelike appendage upturned and densely ciliated along the inner margin, and extending considerably beyond the distal segment and nearly as far as the tip of the antennal scale. The second and third segments are subcylindrical, and, as seen from above, are each about as broad as long, the second being somewhat larger than the third. The inner or major flagellum is about as long as the carapax. The minor flagellum is about as long as the peduncle of the antenna, about half as thick as the base of the major flagellum, of nearly uniform thickness for three fourths its length, then tapers rapidly to a very slender tip, and is thickly ciliated along the inner margin distally.

The first three segments of the peduncle of the antenna are very short, the three together being scarcely longer than the fifth segment. The first segment is loosely articulated with the sternum of the antennal segment, so as to be freely movable upon it ; it is very short upon the outside, but expands somewhat on the inner side, which terminates distally in a thin tubular process arising from the oral side of the segment and directed upward to a level with the dorsal side, so that, in the ordinary position of the appendages, its orifice is closed by contact with the first segment of the peduncle of the antennula. This tubular process readily admits a large bristle, which can be pushed through it round into the cavity of the segment itself. It undoubtedly contains the canal of the green gland. The second segment is small, closely united with the third, and bears upon its outer side a slender scale, which reaches nearly to the tip of the peduncle, is about five times as long as broad, and thickly ciliated along both edges. The third segment, as seen from below, is almost wholly internal to the second, and is armed on the distal part of the inner margin with a small spiniform tubercle. The fourth and fifth segments are subcylindrical, the fourth is slightly longer than the fifth, and both are ciliated each side. The flagellum is about as thick at base and nearly as long as the major flagellum of the antennula.

The buccal opening is nearly square. The branchiostergites extend forward quite over the sternum of the antennary somite, and their anterior extremities are applied to the basal segments of the antennæ, which, however, are freely movable upon the antennary somite. The epistome is short, not extending at all in front of the bases of the antennæ, is nearly on a level with the dorsal

wall of the efferent passages from the branchial chambers and on a plane above the bases of the antennæ, so that the efferent passages terminate in the space between the upturned edges of the squamiform processes of the inner sides of the basal segments of the antennulæ and just beneath the short two-spined rostrum. In the middle of the slightly raised and regularly arcuate posterior edge of the epistome there is a slight elevation with a tuft of hairs. The anterior part of the endostome is on a plane somewhat above the plane of the epistome, but the space below is filled by the soft and fleshy labrum which projects considerably below the raised posterior edge of the epistome.

The mandibles (Pl. IV. fig. 2) are wholly without molar areas and with crowns expanded into very broad and thin lamellæ serrated along the cutting edges with about fourteen acutely triangular teeth, of which one at the anterior angle and one in the middle are much larger and more prominent than the others. The palpus (fig. 2^a) is short, but composed of three segments, of which the proximal is very small ; the second is fully as long as the terminal, and expanded distally, and the terminal about three and a half times as long as broad, and densely setose along the anterior edge and ventral side.

The lobes of the metastome (fig. 2) are very narrow and widely separated. The two lobes of the first maxilla (fig. 3) are very much as described and figured by Willemœs-Suhn in *Willemoesia leptodactyla*, the two lobes being very slender and strongly incurved, and the anterior the larger and with a slight elevation covered with a dense tuft of hairs on the outside near the base.

The second maxilla (fig. 4) has two small and slender protognathal lobes, of which the anterior is very much the larger. The scaphognath is very large, and with the posterior portion very broad and evenly rounded in outline posteriorly, while the anterior portion is much narrower, and reaches forward nearly to the base of the antenna. The endognath is apparently represented by a short and truncate lobe at the base of the anterior lobe of the protognath.

The first maxillipeds (Pl. IV. figs. 5, 5^a, 5^b) are greatly elongated and peculiarly modified. The exopodal lamella (*f*, fig. 5^a) is long and very broad, projects farther back into the branchial passage than the scaphognath, and terminates anteriorly in a small triangular lobe (*g*) ; while the exopod reaches forward considerably in front of the epistome, where its terminal lobes are somewhat upturned and help to enclose the efferent branchial passage. The proximal lobe of the protopod (*a*, figs. 5, 5^a) is triangular and densely setigerous along the edges, while the distal lobe (*a'*) is elongated, and bears the endopod and the peculiarly modified exopod, which lie together, and at nearly a right angle with the protopod. The endopod (*b*, figs. 5, 5^b) is slender, somewhat triquetral, reaches nearly to the bases of the terminal lobes of the exopod, is densely hairy along the edges, is divided near the middle by an imperfect articulation, and lies above and close along the inner edge of the exopod. The exopod (*c*, figs. 5, 5^b) is lamellar, very broad, concave dorsally, divided by several sutures, as shown in the figure, curved inward almost to the mesial line, and encloses the broad efferent passage ventrally and anteriorly. The terminal portion of the exopod is divided into two lobes (*d*, *e*, figs. 5, 5^b), which

are stiff and more calcareous than the rest of the appendage. The outer and anterior of these lobes (*d*) is the larger, and is alone exposed as seen from below in the natural position of the appendages, while the inner (*e*) is somewhat triangular, with a narrow base of attachment, and is curved round above the other lobe, and serves to prolong the dorsal wall of the efferent passage, or, perhaps, as a valve for closing its orifice.

The second maxillipeds (fig. 6) are apparently wholly without exopodal or epipodal branches, and are so short that they reach but little beyond the ischia of the third pair. The ischium and merus are very short, together little more than half as long as the carpus, and both are setigerous along the inner edge, while the ischium has in addition a series of dentiform tubercles. The carpus is about two thirds of the whole length, nearly twice as long as broad, compressed vertically, and much broader in the middle than at either end, and setigerous, but not dentate or tuberculous along the inner edge. The propodus is less than half as long and less than half as wide as the carpus, while the dactylus is still smaller, tapered distally, and terminated in a slender curved and spiniform tip, and both propodus and dactylus are thickly armed with setæ and small spines.

The external maxillipeds (fig. 7) are long and slender, reach, when extended, nearly to the bases of the peduncles of the antennulæ, and are well clothed with hairs and setæ, but unarmed either with teeth or spines. There is a very small and rudimentary appendage (*a*), apparently representing the epipod, upon the outer side of the protopod. The ischium is a little longer than the merus and carpus combined, and a very little stouter than the merus. The merus is about two thirds as long as the ischium, while the three distal segments are subequal in length and together a little longer than the merus, the carpus and propodus tapering slightly distally, while the dactylus is slightly curved and tapers regularly to an acute tip.

The great chelipeds are smooth and naked throughout, except the prehensile edges of the digits of the chelæ, and differ somewhat in size in different individuals, varying in length from about two and a half to nearly three times the length of the carapax, but the differences are apparently entirely independent of sex. The coxa is very stout and broad, far stouter than any of the succeeding segments, and much broader than the coxæ of the other legs. The basis is completely anchylosed with the ischium, which is expanded distally but at the same time strongly compressed vertically, strongly curved upward so as to fit the side of the carapax when turned out at right angles to it, and reaches, in this position, a little above the edge of the carapax, or, when turned forward, to the base or beyond the middle of the antennal scales. The merus is two thirds to four fifths as long as the carapax, compressed like the merus, but considerably expanded proximally, contracted in the middle and distally to near the tip where it is again expanded and thickened at the articulation with the carpus; the posterior edge is armed with an acute spine at the distal extremity, and with either one or two similar ones on the proximal half, while the anterior edge, except near the base, is armed with a scattered series of minute

spines. The carpus is more than half as long as the merus, compressed and very slender to near the distal end where it is expanded and thickened for the articulation of the chela and armed above with a single acute spine and below with one or two small teeth, and along the whole length of the dorsal edge there is a distinct but narrow sulcus. The chela (Pl. IV. fig. 8) is about as long as the merus, and the digits themselves considerably longer than the basal portion, which is about as broad as but much thicker than the proximal part of the merus, though still strongly compressed ; the dorsal edge is evenly rounded, and projects in a small tooth and an acute spine above the articulation of the dactylus ; the inferior edge projects slightly proximally and then retreats at the base of the propodal digit, and except near the proximal end is occupied with a shallow sulcus, the edges of which are armed with several minute spines directed distally. Both digits are compressed, very slender, and regularly tapered to acute and very strongly curved extremities ; the dorsal edge of the dactylus is flattened, but scarcely sulcated, and the inferior edge of the propodal digit is flattened and slightly sulcated near the base, but rounded distally ; the prehensile edges of both digits are armed throughout with a close-set series of very short and very stiff setæ.

The legs of the second pair are slender, densely ciliated along the edges, and reach to the tips of the peduncles of the antennæ. The basis is anchylosed with the rather short ischium. The merus is considerably longer than the ischiobasis and reaches to the edge of the carapax. The carpus is a little shorter than the merus. The basal part of the chela (fig. 9) is a very little longer than the carpus, and is flattened and somewhat expanded distally, where it is a third as broad as long ; the propodal digit is very slender, nearly as long as the basal portion of the chela, nearly straight to the slender, acute, and chitinous tip, which is strongly curved, and the prehensile edge is thin and armed as in the first pair. The dactylus is almost exactly of the same form as the propodal digit, and its prehensile edge is armed in the same way, but the cilia upon the outer edge are much longer than on the corresponding part of the propodus.

The third and fourth pairs of legs are successively a very little shorter than the second, and have very nearly the same form. From the coxal to the meral segment they are very nearly as stout as in the second pair, but the three distal segments are much more slender. The basal part of the chela (fig. 10) is subcylindrical and only very slightly expanded and flattened distally, while the propodal digit and the dactylus are nearly equal in length, very slender and weak, straight throughout, without incurved or chitinous tips, and densely ciliated along the prehensile edges.

The fifth pair of legs (figs. 11 and 12) are considerably shorter and more slender than the fourth, and all the segments except the propodus and dactylus have very nearly the same relative proportions as in that pair. The basal portion of the propodus is alike in the two sexes, a little longer than the carpus, subcylindrical and slightly tapered distally. The digits differ in the sexes. In the male (fig. 11) the propodal digit is about as long as the proximal

thickness of the propodus, or a little longer, slender, and tapers to a rounded tip, while the dactylus is nearly or fully twice as long, considerably stouter, straight, and nearly cylindrical. In the female (fig. 12) the propodal digit is scarcely as long as in the male, is more slender, and tapers to an acute and incurved tip, which is somewhat flattened and excavated on the anterior and inner side, leaving an edge on the posterior side ; the dactylus reaches very nearly to the tip of the propodal digit, and is like it in form, but a little more sharply incurved at tip.

The branchiæ resemble the branchiæ of the Astacidæ, being slender, very soft, and composed of slender filaments, which are not closely crowded together. There are no branchiæ connected with the first and second maxillipeds, but above the base of the third maxilliped and between the lamellar epipod of the first maxilliped and the coxa of the first leg there is a slight lamellar elevation bearing a few filaments which are apparently branchial and may represent a very rudimentary epipodal branchia. The legs of the first four pairs bear each a well-developed podobranchia and a small epipodal plate, lying just at the edge of the carapax but not projecting into the branchial chamber, and above the bases of each of these legs there are two arthrobranchiæ and one pleurobranchia. There is also a pleurobranchia above the base of the fifth leg, so that there are in all sixteen well-developed branchiæ, — four podobranchiæ, eight arthrobranchiæ, and four pleurobranchiæ each side, as indicated in the following formula : —

Somites.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.	Total.
Epipods,	0	0	1	1	1	1	1	0	(5)
Podobranchiæ,	0	0	?	1	1	1	1	0	4
Arthrobranchiæ,	0	0	0	2	2	2	2	0	8
Pleurobranchiæ,	0	0	0	0	1	1	1	1	4
									16+(5)

As seen from above, the sides of the abdomen are nearly straight, and form, with the telson, a regular acute triangle. The first five somites are carinated dorsally, and the carina projects forward from each somite in an acute tooth, but the carina and tooth are small and low on the first somite, increase rapidly to the fourth, while on the fifth they are scarcely as prominent as on the fourth, and on the sixth the carina is inconspicuous and there is no tooth, but the top of the carina is traversed by a narrow longitudinal sulcus. On the first somite there are, in addition, two slender spines each side projecting forward above the articulations with the carapax. The dorsal surface of the abdomen, either side of the median carina, is smooth and scarcely at all sculptured ; but along the lateral margin, where the pleura bend abruptly and nearly perpendicularly downward, there is a series of deep longitudinal sulci, except upon the narrow first somite, which is unsculptured, and upon the sixth, where the sulcus is replaced by a simple carina. Of the pleura themselves, the first is nearly obsolete, the second is broader than deep, projecting back over the third with a broadly rounded margin, and forward in a prominent but rounded angle, and

has a central circular depressed area ; the succeeding pleura decrease regularly in size posteriorly, scarcely overlap when the abdomen is extended, are convex in outline posteriorly but straight or slightly concave anteriorly, and the third, fourth, and fifth are ornamented with a median curved carina extending two thirds of the length, but not well marked upon the fifth.

The telson is pretty regularly triangular, about twice as long as broad, is convex and slightly grooved longitudinally above, and terminates in an acutely rounded tip unarmed with spines. The lamellæ of the uropods scarcely reach the tip of the telson : the outer is nearly as broad as long, regularly rounded in outline except for a short distance on the outer edge near the tip, where the margin is more or less conspicuously truncated, but varying considerably in different individuals, and stiffened by two slightly diverging ribs in addition to the thickening of the outer margin ; the inner lamella is stiffened by a single median rib, is nearly twice as long as broad, the lateral margins are approximately straight and parallel, and the tip is regularly rounded in outline.

In the male the first pair of abdominal appendages (Pl. IV. fig. 14) are much longer than the protopods of the second pair, reach slightly beyond the bases of the fourth thoracic legs, and have an imperfect articulation at about a third of the way from the base to the tip ; the basal portion is somewhat triquetral, while the terminal expands into a smooth, naked, and thin lanceolate lamella slightly concave posteriorly. The second pair reach slightly farther forward than the first, and the protopod and lamellæ are about equal in length. The lamellæ are narrow, lanceolate, and thickly ciliated along the edges ; the inner is about as long as the outer, and bears the two styliform processes usually characteristic of males in the Macrura. These styliform processes are a little less than a third as long as the lamella itself, and arise together at about a third of the way from the base to the tip of the lamella ; the inner, like that upon the three succeeding pairs of appendages, arises from the slightly thickened inner edge of the lamella, is ridged, of nearly equal width to the rounded tip, and nearly naked except a line of cilia along the posterior margin. The outer process arises just in front of the inner, and its base is at a right angle to that of the outer ; it is more slender than the outer, tapers distally, and is ciliated on both edges and on the anterior surface. The three succeeding pairs of appendages are similar to the second pair, but the fourth and fifth pairs are successively a little shorter, and, as usual among Macrura, they all want the outer of the two styliform processes of the inner margin of the inner lamella.

In the female the first pair of abdominal appendages (Pl. IV. fig. 13) are about as long as in the male ; the basal portion, or protopod, is scarcely more than half as long as the terminal lamella, is narrow, compressed, turned inward toward the mesial line, and clothed thickly along the outer and the distal part of the inner edge with long ovigerous hairs ; the terminal lamella is multiarticulate, like the lamellæ of succeeding appendages, but a little narrower than they, and is clothed with numerous ovigerous hairs. The four succeeding pairs of appendages are very nearly like the three last pairs in the male, but the styliform process of the inner lamella is a little larger and more compressed.

The only specimen carrying eggs is the one above referred to as taken off the mouth of Chesapeake Bay. In this specimen the eggs are in an early stage of development, are nearly spherical and .65 to .70 mm. in diameter, and are carried in a mass behind the first pair of abdominal appendages, and between the appendages of the second and third pairs, the mass being principally supported by the first pair, very slightly by the third, and not at all by the fourth and fifth.

Five specimens give the following measurements in millimeters : —

Station	326	898	326	329	326
Sex	♀	♀	♀	♂	♂
Length from front of carapax to tip of telson	60.0	124.0	126.0	83.0	107.0
Length of carapax along median line	26.0	53.2	55.2	36.0	45.3
Breadth of carapax between spines of anterior margin	12.9	25.5	27.3	16.5	23.0
Greatest breadth (in front of cervical suture)	19.3	40.5	41.3	26.7	35.0
Length of first pair of legs *	67.0	140.0	161.0	100.0	125.0
" merus	21.5	42.0	50.0	31.7	39.0
" carpus	12.5	26.0	32.0	17.8	25.0
" chela	21.0	46.0	49.0	30.0	38.5
" dactylus	12.6	27.0	29.0	18.0	22.0
" second pair of legs	22.3	50.0	51.0	32.0	41.5
" merus	6.1	13.3	13.2	8.5	11.0
" carpus	4.0	9.3	9.4	5.2	6.6
" propodus	7.7	17.9	18.5	11.1	14.5
" dactylus	3.9	8.5	8.8	5.2	7.0
" fifth pair of legs	12.5	32.0	32.5	19.0	28.0
" propodus	3.6	10.7	10.5	5.4	7.4
" dactylus	0.9	2.0	2.1	1.4	1.8
" abdomen	34.0	70.0	71.0	47.0	62.0
Greatest breadth at second somite	14.0	34.5	35.0	21.0	30.0
" " sixth somite	7.5	17.3	18.0	11.1	15.0
Length of telson	11.0	23.0	23.0	14.8	20.0
Breadth of telson	5.7	12.2	12.2	7.9	10.5

* In the second, third, and fourth columns the measurements of the first pair of legs are taken from the right leg; in the first and last columns, from the left. In the specimen of which the measurements are given in the fourth column, both legs of the first pair are present and the left one is a little shorter than the right and gives the following measurements : length, 158 mm. ; merus, 47 ; carpus, 31 ; chela, 48 ; dactylus, 28.

CRANGONIDÆ.

Ceraphilus Agassizii, sp. nov.

Plate VII. Figs. 4-5ª.

The carapax is short and broad, and in the female rounded and swollen above and somewhat convex longitudinally. The rostrum (*b*, in figs. 4ª and 5) is hidden from above by the anterior spine (*a*) of the dorsal carina, and is slender, spiniform, and scarcely if at all more prominent than the slender spine forming the outer angle of the orbit each side, and very much less prominent than the slender and acute antero-lateral angles (*d*), which are slightly divergent and reach a little by the bases of the antennal scales in the female, while they are much more divergent and much longer in the male, so that the distance between their tips is considerably greater than the greatest breadth of the middle portion of the carapax. A narrow dorsal carina extends the whole length of the carapax, and is armed with two laterally compressed and spiniform teeth directed forward, and of which the anterior is much the larger, projects immediately above the rostrum, and reaches considerably beyond its tip, while the posterior one is smaller and arises just in front of the cardiac region. There is occasionally a very minute additional tooth in the dorsal carina about midway between these two. On the gastric region either side of the dorsal carina there is a large spine directed forward ; below this is a stout hepatic spine from the upper side of which a prominent carinal ridge extends to near the posterior border, while from its lower edge a similar ridge extends downward and backward a short distance to the branchial region, where it meets a much less distinct carina extending from the antero-lateral angle nearly to the posterior border. There is also a well-marked carina extending backward from the orbital spine (*c*, figs. 4ª, 5, 5ª) along either side of the gastric region and following a distinct suture terminating anteriorly just outside the orbital spine. The lateral margin of the carapax is strongly incurved, and projects inward in a prominent rounded lobe below the base of the first thoracic leg. All the spines of the carapax are proportionally longer in the male than in the female.

The eyes are small and black, and scarcely reach beyond the tip of the rostrum.

The first segment of the peduncle of the antennula is more than twice as long as the second, and the lateral process from its base is very long, and reaches as far forward as the segment itself, which is armed with a tuberculiform prominence at the outer edge of the distal extremity and with a much smaller one on the inner edge ; the second segment is short and has the outer distal angle considerably produced ; the ultimate segment is much broader than long. The flagella are subequal in length and in the female about as long as the peduncle, but in the male about twice as long as the peduncle and the outer longer and very much stouter than the inner or than the outer flagellum of the female.

The antennal scale is about as long as the sixth segment of the abdomen and about twice and a half as long as broad, and the ultimate segment of the peduncle reaches very nearly to the tip of the scale.

The external maxillipeds are much more slender than in *C. boreas* and reach by the tips of the antennal scales about half the length of the ultimate segment, which is no broader than the penultimate but fully twice as long and about six times as long as broad ; the antepenultimate segment is longer than the ultimate.

The thoracic legs are nearly as in *C. boreas*, but are all rather more slender and less hairy. In the first pair the carpal spines are smaller and the chelæ are nearly naked and less swollen than in *C. boreas*. The second pair are nearly as long as the first : the carpus and merus are subequal in length, and each is a little longer than the ischium ; the chela is very slender, about half as long as the carpus, with the digits scarcely a third as long as the basal portion of the chela. The third pair are about as long as the second, the carpus a little longer than the merus, the propodus two thirds as long as the carpus, and the very slender dactylus but little less than half as long as the propodus. The fourth pair do not quite reach the tips of the third, and the fifth reach slightly by the carpi of the fourth.

The abdomen is broad, slightly depressed and rounded above anteriorly, and tapers rapidly to the sixth somite, which is only a little longer than the fifth. The five anterior somites are armed with a median dorsal carina which is conspicuous and flattened above on the fourth and fifth. The epimeron of the first somite is broadly expanded anteriorly and projects in an obtuse tooth below ; the second is broad and evenly rounded in front and behind, and has a slight tooth below, but the inferior edges of the remaining epimera are straight and unarmed. The sixth somite, excluding spines, is about a fourth longer than the fifth, is armed above with four prominent and approximately equidistant carinæ, and the posterior edge projects in a large tooth either side of the base of the telson and in an acute angle at the lateral margin. The carinæ and the teeth on the edges of the epimera are more prominent in the male than in the female.

The lamellæ of the uropods are much shorter than the telson : the outer are from a little more than twice to about three times as long as broad ; the inner are about as long as the outer, and three to four times as long as broad.

The telson is about once and two thirds as long as the sixth somite of the abdomen, flattened and broadly channelled above, tapers regularly to an acute point unarmed with spines but furnished with two pairs of plumose setæ arising from the under side, and the margins are ciliated beneath.

In the male there is a very long median spine on the sternum of each of the four anterior somites of the abdomen, but no similar spines in the female.

The surface of the carapax and abdomen is sparsely clothed with minute pubescence, which is very easily removed with the coating of soft mud with which all the specimens are covered.

The number and arrangement of the branchiæ is the same as in *C. boreas*, and as indicated by the following formula : —

Somites.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.	Total.
Epipods,	1	1	0	0	0	0	0	0	(2)
Podobranchiæ,	0	0	0	0	0	0	0	0	0
Arthrobranchiæ,	0	0	0	0	0	0	0	0	0
Pleurobranchiæ,	0	0	0	1	1	1	1	1	5
									5+(2)

Five specimens give the following measurements in millimeters: —

Station	317	332	326	326	329
Sex	♂	♂	♀	♀	♀
Length from tip of rostrum to tip of telson	42.0	49.0	51.0	70.0	72.0
Length of carapax including rostrum	11.2	12.5	14.7	19.1	19.5
Greatest breadth of carapax anteriorly	7.7	9.4	11.4	15.2	15.3
Breadth between tips of antero-lateral spines	10.3	11.8	11.0	14.0	14.8
Length of anterior dorsal spine	3.5	4.5	3.5	3.7	3.6
" antennal scale	5.6	6.0	6.4	8.1	8.2
" sixth somite of abdomen excluding spines	5.3	5.7	6.3	8.2	8.3
" telson	9.1	10.2	10.3	13.6	14.0

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
317	31° 57′ 0″	78° 18′ 35″	333	2 ♂
326	33° 42′ 15″	76° 0′ 50″	464	1 ♂, 2 ♀
329	34° 39′ 40″	75° 14′ 40″	603	1 ♀
332	35° 45′ 30″	74° 48′ 0″	263	1 ♂, 4 ♀

A young specimen was taken in the U. S. Fish Commission dredgings off Block Island, in 1880, Station 891, N. Lat. 39° 46′, W. Long. 71° 10′, 500 fath.

Pontophilus Norvegicus M. Sars.

Crangon Norvegicus M. Sars, Nyt Magazin Naturv., Christiania, XI. p. 248, 1861.
Goes, Öfversigt Vetenskaps-Akad. Förhandlingar, Stockholm, 1863, p. 173 (13).

Pontophilus Norvegicus M. Sars, Christiania Videnskabs-Selskabs Forhandlinger, 1861, p. 183; Nyt Magazin Naturv., Christiania, XII. p. 290 (38), 1863; XV. p. 242 (2), Pl. I. figs. 1–25, Pl. II. figs. 17–37, 1868.

G. O. Sars, Nyt Magazin Naturv., Christiania, XV. p. 95 (14), 1866; Christiania Videnskabs-Selskabs Forhandlinger, 1871, p. 261 (18), 1872; Archiv. Mathem. Naturvidensk., Kristiania, II. p. 340, 1877.

Metzger, Jahresber. Comm. wissensch. Untersuchung deutschen Meere, 1872–73, Nordsee, p. 291, 1875.

S. I. Smith, Trans. Conn. Acad., New Haven, V. p. 61, 1879; Proc. National Mus., Washington, III. p. 435, 1881.

?? *Hippolyte costata* Leuckart, Wirbelloser Thiere mit Fauna norddeutsch. Meeres, p. 159, 1847.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
306	41° 32′ 50″	65° 55′ 0″	524	5
309	40° 11′ 40″	68° 22′ 0″	304	7

Pontophilus brevirostris Smith.

Proc. National Mus., Washington, III. p. 435, 1881.

Plate VII. Figs. 1-1b.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
314	32° 24′ 0″	78° 44′ 0″	142	15
315	32° 18′ 20″	78° 43′ 0″	225	2
321	32° 43′ 25″	77° 20′ 30″	233	1
327	34° 0′ 30″	76° 10′ 30″	178	25
333	35° 45′ 25″	74° 50′ 30″	65	2
344	40° 1′ 0″	70° 58′ 0″	129	6
345	40° 10′ 15″	71° 4′ 30″	71	20

This species is very closely allied to *P. spinosus* and *P. Norvegicus*, but is readily distinguished from them by the very short rostrum, which is tridentate, with the median tooth scarcely broader and very little longer than the lateral, about reaching to the cornea of the inner side of the eye and not projecting beyond the line of the spiniform outer angles of the orbits. The proportions of the body are more like *spinosus* than *Norvegicus*, but the carination and armature of the carapax are more like *Norvegicus*, while the sculpture of the distal somites of the abdomen is more like *spinosus*.

The dorsal carina of the carapax is armed with three spines, and frequently a smaller fourth one in front of the others and just back of the base of the rostrum ; the subdorsal carina is armed with two spines, as in *Norvegicus*, and often with a rudiment of a third behind these ; the lateral carina does not extend back of the middle of the carapax, and is armed with a single spine, as in *Norvegicus*. There are no distinct carinæ on the first four somites of the abdomen, but the fifth somite is flattened above and has subdorsal carinæ slightly diverging posteriorly, and below these, each side, another carina, nearly parallel with the subdorsal ; and the sixth somite is flattened above and subdorsally carinated, as in *spinosus*, though the carinæ are not quite as conspicuous on either somite as in that species.

The eyes, antennulæ, and antennæ are very nearly as in *P. spinosus*. The external maxillipeds reach a little beyond the tips of the chelipeds, the penultimate segment reaches nearly to the tip of the antennal scale, and the ultimate segment is a little less than twice as long as the penultimate, while in *P. Norvegicus* it is about once and a half as long, and in *P. spinosus* much more than twice as long, as the penultimate segment. The thoracic legs differ scarcely at all from those of *P. spinosus*.

The lamellæ of the uropods are very nearly as in *P. spinosus*. The inner lamella reaches nearly or quite to the tip of the telson, is lanceolate, and six or seven times as long as broad ; the outer lamella is about a tenth shorter than the inner, and about four times as long as broad. The telson is once and a fourth to once and two fifths as long as the sixth somite of the abdomen, is very narrow, slightly acuminate, and has a very narrow and acutely triangular tip,

armed with only two very long, slender, and plumose setæ, which arise near together from the under side.

It appears to be a much smaller species than either *Norvegicus* or *spinosus*, the largest males being scarcely 25 mm. in length and the largest females about 36 mm.

This species was taken in great abundance, in 51 to 155 fathoms, off Block Island, in 1880 and 1881, by the U. S. Fish Commission. The specimen figured is from the Fish Commission collection, Station 873, 100 fathoms.

Pontophilus gracilis, sp. nov.

Plate VII. Figs. 2 - 3ᵃ.

This species is very much more slender and has much larger eyes than any other species of the genus known to me. It is represented in the collection by a single specimen, which is possibly immature, but, judging from the structure of the appendages of the first and second somites of the abdomen, is a female.

The carapax is nearly twice as long, along the dorsal line, as broad, slightly carinated, and so thin that the branchiæ are readily seen through it. The rostrum is about two sevenths as long as the rest of the carapax along the dorsal line, very slender, and the lateral teeth scarcely a third of the way from the base to the tip. The dorsal carina is not distinct except where it rises into two acute teeth directed forward, one on the gastric region and one on the anterior part of the cardiac. There is a slight lateral carina in the middle portion of the carapax, terminating anteriorly in a spine like those in the dorsal carina. A little farther down upon the carapax and a little in front of the anterior spine of the dorsal carina there is a small hepatic spine, making in all six spines exclusive of those of the anterior margin. The orbit is very broad and its outer border extends far forward and terminates in a slender spine, while the similarly slender spine of the antero-lateral angle extends still farther forward nearly or quite to a line with the tip of the rostrum.

The eyes are very large and reach to about the tip of the rostrum ; the cornea is oblique, somewhat compressed vertically, and its greatest breadth considerably more than the breadth of the antennal scale. The peduncle of the antennula scarcely reaches the middle of the antennal scale, and the lateral process from the base of the first segment reaches to the distal extremity of the segment itself ; the outer flagellum is slender and reaches to the tip of the antennal scale ; the inner is about a third longer, but scarcely stouter, than the outer. The antennal scale is about three fourths as long as the carapax exclusive of the rostrum, about four times as long as broad, only very slightly narrowed distally, and the tip evenly rounded. The distal segment of the peduncle is a little more than half as long as the scale, and the flagellum is slender and about twice as long as the carapax exclusive of the rostrum.

The first and second maxillipeds are nearly as in *P. Norvegicus*. The external maxillipeds reach by the tips of the antennal scales by fully half the

length of the distal segment, which is a little longer than the penultimate, but only a little more than two thirds as long as the antepenultimate, while the two distal segments together are about as long as the antennal scale.

The anterior thoracic legs are very slender, reach a little beyond the tips of the antennal scales, and the chela itself is smooth, naked, strongly compressed distally, a little shorter than the antennal scale, about as long as the diameter of the carapax, and, excluding the very prominent distal spine of the inner margin, about a fourth as wide as long. The second legs are very small, as in the other species of the genus, slender, and scarcely reach the middle of the meri of the anterior pair. The third are very slender, about twice as long as the carapax, reach by the tips of the antennal scales the full length of the propodi and dactyli, which taken together are very nearly as long as the carpi, the dactyli being very slender and acute and about half as long as the propodi. The fourth and fifth legs are about as long as the first pair, and sparsely clothed with long hairs except upon the dactyli, which are strongly compressed vertically, about two thirds as long, and toward the base as broad, as the propodi.

The abdomen to the tip of the telson is about three times as long as, and slightly narrower than, the carapax. The sixth somite is more than a fifth of the entire length, compressed laterally so that the breadth is less than a fourth while the height is fully two fifths of the length, and flattened or obscurely channelled longitudinally in the middle of its length above. The telson is about as long as the sixth somite, very slender, flattened but scarcely channelled above, and the narrow tip armed with four very slender spines of which the median are twice as long as the lateral. The inner lamella of the uropod is as long as the sixth somite, projects considerably by the tip of the telson, is lanceolate, and more than five times as long as broad. The outer lamella is considerally shorter and slightly broader than the inner.

The inner lamella of the appendage of the first abdominal somite (Pl. VII. fig. 2^b) is about as long as the protopod, linear, and the margins not ciliated; the outer lamella is narrow-ovate, considerably longer than the inner, and of the usual structure. The inner lamella of the appendage of the second somite (fig. 2^c) is a little shorter and much narrower than the outer, and has a single stylet two fifths as long as itself arising from the inner margin near the base.

Length from tip of rostrum to tip of telson	30.0 mm.
Length of carapax including rostrum	7.8
Length of rostrum	1.7
Greatest breadth of carapax	4.1
Length of antennal scale	4.5
Breadth of antennal scale	1.1
Greatest diameter of eye	1.4
Length of sixth somite of abdomen	4.9
Length of telson	5.0

Station 315, N. Lat. 32° 18′ 20″, W. Long. 78° 43′; 225 fathoms.

Since the above description was written a specimen of this species has been taken in 458 fathoms, by the U. S. Fish Commission, Station 1029, off Martha's Vineyard. This specimen, an adult male 28 mm. long, agrees perfectly with the female except in the usual sexual characters, and proves beyond question that the specimens are adult, though the female is probably not fully grown. The eyes in the male are fully as large as in the female. The inner flagellum of the antennula reaches nearly half its length by the antennal scale, while the outer is only a little shorter than the inner, but very stout, fusiform, with the diameter at the thickest point equalling nearly half the breadth of the antennal scale. The inner lamella in the first pair of abdominal appendages (Pl. VII. fig. 3) is only half as long and less than half as broad as the outer, and almost entirely naked. In the second pair (fig. 3ª) the inner lamella is nearly as long as the outer, but only about two thirds as broad, lanceolate in outline, furnished with plumose marginal setæ like the outer, and bears the two stylets characteristic of the male at about a fourth of the way from the base to the tip of the inner margin. The marginal or major stylet is like the single stylet of the female and of the succeeding appendages of the male, about two fifths as long as the lamella itself, very narrow, and almost entirely naked except the usual hooklike setæ near the tip, while the minor stylet is a little stouter than the other, but only about a fourth as long as the lamella, and naked except a few minute hairs near the tip.

Sabinea princeps, sp. nov.

Plate VIII. Figs. 1-1ᵇ.

Carapax with seven carinæ as in the other species of the genus, but with an acute rostrum as long as the antennal scales or longer, and armed above with a spine either side near the base and below with a single spine. The dorsal carina is very high, sharp, slightly arched longitudinally, and armed, from a little back of the orbit to the posterior margin, with seven or eight somewhat irregular teeth directed forward. The rostrum varies very much in length, in the male being often only a little shorter than the length of the carapax from the orbit to the middle of the posterior margin, but in large females often only half as long ; dorsally it is flattened and the margins slightly carinated, but beneath the edge is angular ; the basal portion is nearly horizontal, but the terminal portion is upturned and acute ; below the margin is armed with a slender spiniform tooth directed forward from the point where the terminal portion is upturned, and above with a similar tooth arising from the dorsal margin over either eye and directed outward and upward. The three carinæ each side of the carapax have about the same position as in the other species of the genus. The subdorsal is continuous almost to the orbit, and is armed with six or seven spiniform teeth directed forward. The next carina below is broadly interrupted on the anterior region, but back of this is armed with five or six teeth like those of the subdorsal carina, and in front, at the outer margin

of the orbit, with a prominent slender and acute spine. The lower lateral carina is very prominent anteriorly and is armed with nine to twelve spiniform teeth, of which the three or four most anterior increase in size very rapidly, the anterior one forming a great and somewhat laterally expanded spine nearly or quite half as long as the rostrum, and reaching nearly to, or in the male often considerably beyond, the middle of the antennal scale.

The eyes are black, very large, pyriform, and including the peduncles much longer than the greatest diameter, which is about two thirds the breadth of the antennal scale.

The peduncle of the antennula reaches to about the middle of the antennal scale ; the flagella are subequal in length, in the female a little longer than the antennal scale, but in the male much longer and the outer very much stouter than in the female, and considerably thickened vertically.

The antennal scale is about a third as long as the carapax including the rostrum, and is itself of nearly the same form as in the allied species, but there is a prominent and acute spine near its base upon the outer edge of the second segment. The distal segment of the peduncle is very long, reaching nearly to the tip of the antennal scale, and the flagellum in the male is about as long as the abdomen, but considerably shorter in the female.

The external maxillipeds are slender, reach considerably beyond the tips of the antennal scales, and the proportions of the segments and of the exopods are almost exactly the same as in the other species of the genus.

The anterior legs reach to the tips of the antennal scales : the outer distal margin of the merus is prolonged into a slender spine, and there is a similar one upon each of the two outer distal angles of the carpus ; the chela is about as long as the merus, very stout, somewhat swollen, and nearly cylindrical at base, but compressed and expanded on the inner side distally, the prehensile edge nearly transverse, slightly arcuate, and armed with a very large spiniform tooth at the inner margin. The rudimentary second legs are small, very slender, and reach to the distal end of the ischia of the first : the ischium and merus are subequal in length and each much longer than the three distal segments, of which the carpus and propodus are subequal, while the dactylus is very small, only a little longer than the diameter of the propodus. The third legs reach slightly beyond the first, and the dactylus is very slender and acute, but only about one sixth as long as the propodus. The fourth and fifth are nearly equal in length, and the fourth reach to the tips of the third : the dactyli are about half as long as the propodi, very slender, with the upper surfaces densely ciliated.

The carinæ of the abdomen have the same arrangement as in *S. Sarsii*, but are much more conspicuous, and each of the epimera of the first two somites projects below into an acuminate spine, while the epimera of the third, fourth, and fifth somites are each armed with two similar spines. The dorsal carina upon the posterior half of the second somite is double, or rather V-shaped with the apex directed forward. The dorsal carina upon the third and fourth somites is very conspicuous, and upon each is prolonged in a tooth at the

posterior margin, the tooth upon the fourth being prominent and horizontal and occasionally having a secondary tooth above its base. The two dorsal carinæ of the fifth somite are high and sharp, and each armed with a sharp tooth near the middle and with a similar one projecting over the posterior margin. The sixth somite is about once and a half as long as the fifth, its dorsal carinæ are very high and sharp and each armed with five to seven acute teeth of which the posterior project over the margin as in the fifth somite; the posterior margin is in addition armed with two spines each side, one at the inferior angle and another above the base of the telson.

The outer lamella of the uropod is a little longer than the sixth somite, about twice and a half as long as broad, and obtusely rounded at the tip; the inner is longer than the outer, ovate-lanceolate, and not quite a third as broad as long.

The telson is about once and a half as long as the sixth somite, tapers regularly throughout, and is ornamented above with two carinæ converging to the tip, which is acute, unarmed, and naked.

All the exposed surfaces of the carapax and abdomen except the spines and carinæ, and a considerable part of the surface of the appendages, are clothed with a very short and dense pubescence, which readily brushes off with the soft mud with which most of the specimens are covered.

Six specimens give the following measurements in millimeters: —

Station	326	326	337	326	326	312
Sex		♂	♂	♂	♀	♀
Length from tip of rostrum to tip of telson	56.0	65.0	89 0	98.0	77.0	125.0
Length of carapax including rostrum	21.0	23.2	33.5	35.0	28.5	49.5
Length of rostrum	9.2	9.6	15.5	13.5	12.0	21.0
Length of antennal scale	7.0	8.1	11.5	12.5	9.2	15.0

The eggs are very large, being, even in alcoholic specimens, about 2.5 and 3.0 mm. in least and greatest diameter, while in *S. septemcarinata* they are about 1.0 by 1.4 mm. in alcoholic specimens.

The number and arrangement of the branchiæ are the same as in *S. septemcarinata*, and may be indicated by the following formula: —

Somites.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.	Total.
Epipods,	1	1	0	0	0	0	0	0	(2)
Podobranchiæ,	0	0	0	0	0	0	0	0	0
Arthrobranchiæ,	0	0	2	0	0	0	0	0	2
Pleurobranchiæ,	0	0	0	1	1	1	1	1	5
									7+(-)

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
312	39° 50′ 45″	70° 11′ 0″	466	1 ♀
326	33° 42′ 15″	76° 0′ 50″	464	10 ♂, 9 ♀, 3 young.
337	38° 20′ 8″	73° 23′ 20″	740	1 ♂

Also obtained in the U. S. Fish Commission dredgings off Block Island in 1880, Station 892, N. Lat. 39° 46′, W. Long. 71° 5′, 487 fathoms; and Station 893, N. Lat. 39° 52′ 20″, W. Long. 70° 58′, 372 fathoms.

The long and spined rostrum and the long spines and teeth of the carapax and abdomen give this gigantic species a very different aspect from the other species of the genus; but the oral appendages, the number and arrangement of the branchiæ, and other structural details, agree perfectly with *S. septemcarinata*, the type species of the genus. The present species is, however, much more closely allied to *S. Sarsii* Smith (Trans. Conn. Acad., V. p. 59, Pl. II. figs. 6–8, 1879) than to *septemcarinata;* the elongated and acute rostrum, the prominent dentation of the carapax and abdomen, and the structure of the telson in *Sarsii* show a marked approach toward the *princeps*, although the two species are very different in general appearance.

Sabinea hystrix (*Paracrangon hystrix* A. Milne-Edwards, Ann. Sci. Nat., 6me série, XI. No. 4, p. 6, 1881), from 730 fath., near Guadaloupe, is very closely allied and probably identical with this species, which, though externally somewhat like *Paracrangon echinatus* Dana, differs essentially in several structural features in which, as pointed out above, it agrees with the typical species of *Sabinea*. In *Paracrangon echinatus*, not only are the second pair of legs completely obsolete, but there are no arthrobranchiæ, the branchial formula being the same as for *Ceraphilus boreas* and *Agassizii*.

RHACHOCARINÆ, subfam. nov.

Anterior thoracic legs stout, non-chelate; second pair slender, chelate, and with multiarticulate carpi; coxæ of the external maxillipeds articulated with the adjacent edge of the carapax.

These characters sufficiently distinguish this subfamily from all other Crangonidæ. The broad, ovate antennal scales with both margins ciliated are probably also characteristic of the subfamily, which, as far as known to me, contains but one genus.

RHACHOCARIS,* gen. nov.

Plates V. and VI.

The carapax is subcylindrical, carinated longitudinally, rostrated, with prominent antero-lateral and antennal spines, and the margins of the branchiostegites are strongly incurved opposite the bases of the second pair of legs and are connected each side with the coxæ of the external maxillipeds by two processes from the coxa interlocking between their converging tips a projection in the margin of the carapax so as to form therewith an articulation admitting slight motion.

The eyes are large and pyriform, with the cornea expanded and very large. The antennulæ are very nearly as in *Crangon*. The antennal scale is broad,

* Ῥάχις and καρίς.

ovate, the entire margin ciliated, and with the tooth of the outer margin small and far back from the tip. The other parts of the antenna are nearly as in *Crangon*. The oral appendages are very similar to those of *Crangon* and the closely allied genera, and the labrum, metastoma, mandibles, maxillæ, and second pair of maxillipeds are very nearly as in *Crangon vulgaris*. In the first maxilliped the proximal lobe of the endopod projects inward much more prominently and the distal lobe is longer than in *Crangon*. There are two arthrobranchiæ at the base of the external maxilliped, as in *Sabinea*, and the stout endopod is composed of three segments as in Crangoninæ, but the two distal segments are very short and the terminal one acute and spined.

The legs of the first pair are symmetrical and about as large as the external maxillipeds ; the propodus is short and tapers distally, and the dactylus is small, slender, and capable of flexion against the inner side of the propodus. The legs of the second pair are elongated, slender throughout, and, in all the specimens examined, slightly unsymmetrical in length ; the carpi are long and multiarticulate ; and the chelæ small. The last three pairs of legs are slender and nearly alike.

The number and arrangement of the branchiæ differ from all the Crangonidæ known to me. In *R. sculpta*, the second species here described, there are epipods on the bases of the first and second maxillipeds and two arthrobranchiæ at the base of each external maxilliped, one arthrobranchia for each of the thoracic legs except the last pair, and a pleurobranchia for each side of the last five thoracic somites, — making two epipods, six arthrobranchiæ, and five pleurobranchiæ each side, as indicated in the following formula : —

Somites.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.	Total.
Epipods,	1	1	0	0	0	0	0	0	(2)
Podobranchiæ,	0	0	0	0	0	0	0	0	0
Arthrobranchiæ,	0	0	2	1	1	1	1	0	6
Pleurobranchiæ,	0	0	0	1	1	1	1	1	5
									11+(2)

The abdomen is sculptured and spined to correspond with the carapax, and the exoskeleton is throughout very thick and massive.

In the three species here described, the hinges at the last three articulations of the abdominal somites — that is, at the articulation of the fifth with the fourth, the sixth with the fifth, and of the telson with the sixth — present a peculiar modification by which the hinge is very much strengthened and is at the same time apparently made capable of being clamped or locked so as to hold the terminal somites firmly extended. In addition to the ordinary hinge, at each of these articulations, there is a process arising from the anterior somite just below the hinge and curved backward and upward concentrically with the hinge, and this process fits accurately and is slightly overlapped along its edges by a similarly curved groove in the posterior somite. When the abdomen is completely flexed the ends of these curved processes project dorsally consider-

ably beyond the grooves, but when the abdomen is fully extended the processes are withdrawn so as to expose the dorsal part of the groove, and in this position in the contracted alcoholic specimens the somites are firmly clamped, apparently by the pressure of the ends of the processes upon the concave posterior walls of the grooves, and held rigidly extended, so that it is very difficult to flex the somites, unless the tip of the abdomen is pulled backward with considerable force, when the processes slide easily through the grooves and the somites are readily flexed. It is probable that in life, while the extensor muscles of the abdomen are relaxed, the processes move easily through the grooves; but when the extensor muscles are strongly contracted the hinges are clamped as in the alcoholic specimens, so that the animal can voluntarily hold the telson and the spiny terminal somites of the abdomen rigidly extended as a means of self-defence.

In all three of the species, when the abdomen is fully flexed, the tip of the telson is brought directly below and very near to the mouth.

A. Milne-Edwards, in the paper already referred to, which has been published since the part of this report relating to the Crangonidæ was ready for the printer, has described three new species belonging to a new genus, *Glyphocrangon*, which is apparently very closely allied to the genus here described and possibly identical with it. In Milne-Edwards's genus the telson is described as consolidated with the sixth somite of the abdomen.* It is scarcely to be supposed that Milne-Edwards could mistake the peculiar articulation of the telson with the sixth somite of the abdomen, which is described above and which is equally characteristic of the articulation of the sixth somite with the fifth and of the fifth with the fourth, for actual consolidation, or overlook the remarkable character of the articulation of the external maxillipeds with the carapax; and as neither of the species here described and figured agrees fully with the description of either of the species of *Glyphocrangon* in the spines of the carapax and abdomen, I am forced to the conclusion that Milne-Edwards's genus is different from mine, though possessed of quite as remarkable characters.

Rhachocaris Agassizii, sp. nov.

Plate V. Fig. 2. Plate VI. Fig. 2.

Female. — The carapax has eight conspicuous longitudinal carinæ which are interrupted by a very deep cervical and a broad and deep gastro-orbital sulcus, but, aside from the carinæ, sulci, and spines, is nearly cylindrical. The rostrum is about two thirds as long as the rest of the carapax along the dorsal line, flat-

* In characterizing the genus he says, "Le septième article abdominal est presque entièrement soudé au sixième"; and in the description of *G. spinicauda*, the first species, "Le septième article est immobile sur le précédent, il est triangulaire, bicarené en dessus, très pointu, et au lieu d'avoir la même direction que les autres articles, il se relève et son extrémité est dirigée en haut."

tened above, triangular but with the edge flattened and distally slightly grooved below, and tapers regularly to an acute and gently upturned tip ; above there is a narrow but distinct median carina extending the whole length, and the margins are carinated and each armed just above the front of the eye with a prominent and acute spine directed forward and upward; below the rostrum is unarmed. Just back of the base of the rostrum there is a pair of spines like those upon the rostrum, but slightly larger and with the bases elongated and laterally compressed. From these teeth two parallel dorsal carinæ extend to the posterior margin, but each one is broken into ten or eleven elongated teeth turned slightly forward, truncated above, and all except the first and last with flattened and conspicuously punctate tops. The space between these carinæ is concave with a deep transverse depression at the cervical suture, but smooth except a few small tubercles along the carinæ and one on the median line in front. The frontal margin is transverse and nearly straight, but the lateral angle is armed with three very large and acute spines : a very slender antennal spine directed upward and forward from just above the base of the antenna ; directly below this a somewhat larger one (the lateral angle itself) slightly compressed laterally and curved downward and then directed forward below the antennal scale ; and, arising outside and a little back of these, a very broad, dentiform, vertically compressed spine directed outward and forward, terminating in an acute tip as far forward as the tip of the antennal spine, and apparently representing the anterior part of the lower of the three lateral carinæ, but separated from it by the broad and very deep depression of the cervical suture. The broad triangular space between this carinal tooth and the gastric region is depressed and smooth. The posterior part of the middle lateral carina is prominent and terminates at the cervical suture in a long tooth directed forward ; posteriorly it extends to the posterior margin and has the edge thick, flattened and punctate. The upper of the lateral carinæ is not evident in front of the cervical suture, is less conspicuous than the dorsal, and is obscurely divided into about four truncated teeth flattened and punctate above. On the gastric region in front of this carina there is an irregular group of elongated tubercles extending to the gastro-orbital suture, but with this exception the sides of the gastric region are unarmed, as are the remaining spaces between the carinæ of the dorsal part of the carapax, except a few very small tubercles either side of the cardiac region, and a few still smaller ones below the upper lateral carina and near the posterior margin. The lower of the lateral carinæ is broad, punctate along its edge, and extends from near the base of the spine of the antero-lateral angle almost to the posterior margin, with a broad and deep interruption at the cervical suture. On the branchial region below this carina there are about three irregular elongated and punctate ridges, and near the posterior margin there are a few small tubercles, but with these exceptions the branchial regions are unarmed. There is, however, a narrow but well-marked carina the whole length of the lateral margin.

The eyestalks are slender and very small in proportion to the eyes themselves, which are approximately spherical, slightly compressed vertically, and

with the horizontal diameter about three fourths as great as the breadth of the antennal scale and only a little less than the length of the eye to the base of the stalk. In the alcoholic specimen, the pigment is deep purplish and is probably not black in life.

The peduncle of the antennula reaches to the tip of the antennal scale and nearly to the tip of the rostrum, and is clothed along the sides and below with very fine hairs, but is nearly naked above; the first segment is a little longer than the second and third together, the second nearly as long as the last, which is less than twice as long as broad. The flagella are both nearly naked: the outer is about as long as the peduncle, the proximal two thirds of its length vertically compressed and broad, but the terminal portion suddenly contracted; the inner is a little longer than the outer, very slender and regularly tapered.

The antennal scale is regularly ovate, with the greatest breadth about two thirds of the way from the tip to the base, where it is very much contracted at the articulation; both margins are thickly ciliated, and the tooth of the outer margin is represented by an obscure angular projection at less than a third of the way from the base to the tip. The narrowness of the articulation permits great lateral motion in the scale, so that it may be turned outward at nearly a right angle to the body. The segments of the peduncle are without spines or tubercles; the last segment is about as long as the breadth of the scale and reaches three fourths of the way from its base to its tip, and the inner edge is compressed and ciliated. The flagellum is a little longer than the carapax including the rostrum, slender, compressed vertically, and almost naked.

The tips of the external maxillipeds reach to about the tips of the antennal scales. The proximal of the three segments of the endopod is about as long as the antennal scale and five or six times as long as broad; the second segment is about two fifths as long as, and slightly broader than, the first, vertically compressed, thickly ciliated along the inner edge, and armed beneath with a single movably articulated spine near the distal end, and with two or three similar spines along each edge; the last segment is a little longer than the second, flat and smooth above, tapers from the base to a slender curved and acute tip, and the under surface and lateral margins are armed with thirteen or fourteen movably articulated spines among which there are a few fascicles of setæ. The exopod is very slender, the basal portion slightly longer than the flagelliform portion, and the whole considerably shorter than the proximal segment of the endopod.

The legs of the first pair are just about as long as and scarcely stouter than the external maxillipeds, and reach a little beyond the bases of their dactyli, or nearly to the tips of the peduncles of the antennæ: the ischium is about as long as the propodus, the inner and outer margins nearly parallel, the outer articulating with the merus, while the inner is thin, nearly straight, closely approximated, and armed with a few setæ, and each projects forward beyond the articulation with the merus in a narrow dentiform prominence; the merus is as long as the three distal segments together, about a fourth as long as broad, slightly compressed vertically and with a few setæ along the inner edge, but

otherwise unarmed ; the carpus is short, about as broad as long, and unarmed, and is so articulated with the merus as to be capable of flexion backward and beneath it ; the propodus is slightly more than half as long as the merus, rounded, slightly swollen, tapers to a very narrow distal extremity, and is smooth and unarmed except upon the upper and inner side where it is furnished with three longitudinal series of fascicles of soft setæ ; the dactylus is about half as long as the propodus, very slender, curved and acute, smooth and naked, and capable of nearly complete flexion on the setigerous side of the propodus. The manner in which the distal segments of these limbs are articulated brings the setigerous sides of the propodi and the points of the dactyli in direct opposition to the spinous sides of the two distal segments of each of the external maxillipeds, and these two pairs of appendages are probably used together as prehensile organs.

The legs of the second pair are unarmed and naked, very slender, the distal portion but little stouter than the proximal part of the flagellum of the antenna, and a little unsymmetrical, the left being slightly stouter than the right and reaching nearly to the tip of the rostrum, while the right reaches a little beyond : the coxa is short and nearly cylindrical ; the ischium is a little longer than the propodus in the first pair, much broader than the coxa, very much compressed vertically and the inner edge slightly expanded proximally, so that the breadth is about a fourth of the length ; the merus is about a fourth longer than the ischium, the right a little longer than the left, little more than half as broad as the ischium, nearly uniform in breadth, and compressed vertically but much less so than the ischium ; the carpus is more than twice as long as the merus and more slender, strongly compressed, very slightly tapering at the distal end, composed of thirty-one segments on the right side and twenty-three on the left, and the most distal segment in each about as long as the three next taken together ; the left chela is slightly larger than the right, but neither is larger than the distal segment of the carpus, the digits are both short, the prehensile edge of the propodal one considerably oblique and shorter than the dactylus, which is itself scarcely longer than the breadth of the propodus.

The legs of the third pair are nearly naked, slender, and reach to the tip of the rostrum : the merus is about twice as long as the ischium, and these two segments taken together are longer than the three distal segments and are of nearly uniform diameter throughout and very slightly compressed ; the carpus is a little shorter and more slender than the ischium ; the propodus is nearly twice as long as the carpus, cylindrical, and slightly tapered distally ; the dactylus is narrower than the distal end of the propodus, nearly a fourth as long as the propodus, nearly straight, a little compressed vertically, and tapered from the base to the tip. The fourth and fifth pairs of legs are alike and very similar to the third pair, but are slightly stouter throughout, the propodus is furnished with a dense fascicle of setæ outside the base of the dactylus, and the dactylus itself is considerably longer than in the third pair, strongly compressed vertically, concave above and convex below, and lanceolate, being broader in the middle than the distal end of the propodus, but narrowed toward the base and tapered to an acute tip.

The sternum is flat, triangular, and wholly unarmed.

The abdomen is about once and a half as long as the carapax including the rostrum, is narrower than the carapax, and as seen from above tapers regularly from the base to the tip of the telson. There is a sharp medio-dorsal carina from the base to the telson, but interrupted on all the somites but the first ; a single lateral carina each side is indistinctly indicated on the first two or three somites ; and the dorsal surface generally is studded with prominent tubercles, many of which are elongated and all the larger ones with flattened and punctate tops. Upon the first somite, the median carina is thin and very high and projects forward in an acute tooth ; either side, in line with the upper lateral carina of the carapax, there is a very prominent acute and spiniform tooth directed obliquely forward. On the second and third somites, the dorsal carina is divided into two nearly equal parts by a smooth and very conspicuous sulcus, which passes slightly backward either side across the whole dorsum of the segment and down parallel with and near to the posterior margin of the epimeron ; the anterior part of the carina on the second somite is nearly as high as on the first and projects slightly forward, but the posterior part on the second and both parts on the third are much lower and do not project in front or behind. On the fourth somite, the carina is divided into two unequal parts by a less conspicuous sulcus, the anterior part being like that upon the third somite, while the posterior part is twice as long, thickened and flat above anteriorly, but posteriorly higher, more acute, and projecting slightly over the fifth somite. On the fifth somite the carina is unequally divided by a similar sulcus, but the anterior portion is more prominent than on the fourth, and the posterior part is very prominent, its anterior half being formed of two longitudinally elongated tubercles slightly diverging posteriorly, and between and back of them a single very high sharp and triangular tooth. The carina upon the sixth somite is broken anteriorly by a small notch, and posteriorly rises in an acute edge and projects far back over the base of the telson in an acute tooth. The epimeron of the first somite is narrow, does not project below the margin of the carapax, is rounded below and almost wholly covered by the anterior expansion of the epimeron of the second somite when the abdomen is fully flexed. The epimeron of the second somite projects much below the epimeron of the first, the anterior margin is nearly as convex in outline as the posterior, the inferior margin projects in the middle in a very long, slender, and outcurved spine, in a much smaller spine at the posterior angle, and in a small tooth anteriorly ; on the outer surface a sulcus, like and nearly parallel with the sulcus of the porterior border, passes from near the anterior hinge to the base of the large spine of the inferior margin, but between and outside of the sulci the surface is sparsely tuberculous. The epimera of the third, fourth, and fifth somites have a smooth depressed area along the anterior margin, and are each armed below with two slender acute and out-curved spines, of which the anterior one on each epimeron is about as long as the large spine of the second epimeron, while the posterior spines increase in length from the second to the fifth somite, that upon the fifth epimeron being longer than the anterior spine of the same

epimeron and directed backward as well as outward ; the middle portion of the outer surface of each of these epimera is raised and sparsely tuberculous, and there is also a line of small tubercles between the sulcus and the posterior margin on the third, but on the following epimera the transverse sulcus of the dorsum does not extend down the epimera. Most of the tubercles on the side of the sixth somite are arranged in two longitudinal lines, an irregular but prominent one between the two hinges and a less prominent one below. The lateral angles of the sixth somite project downward, outward, and backward in a very large and acute spine outside the base of the uropod.

The telson is a little longer than the rostrum, slightly expanded toward the base, but the distal two-thirds is narrow, and terminates in a slender spiniform and slightly upturned tip unarmed with spines or setæ. On the dorsal side there is a sharp median tooth beneath the projecting carinal tooth of the sixth somite ; either side there is a sharp carina extending from the base nearly to the tip, leaving, except at the base, a smooth and deep groove between them ; the lateral edges are strongly carinate, leaving a smooth groove either side, and a wide and shallow groove the full width of the under surface.

The lamellæ of the uropods are about three fourths as long as the telson : the inner lamella is obtusely lanceolate and nearly four times as long as broad ; the outer is much broader, the tip ovately rounded, and the very prominent lateral tooth about a fourth of the way from the tip to the base.

The inner lamella of the appendage of the first abdominal somite is very short, about a third as long as the outer, obtuse, and about half as broad as long.

The sterna of all the abdominal somites are unarmed.

The eggs are very large, being, in alcohol, about 2.6 and 3 mm. in least and greatest diameter, and are proportionally few in number, there being not far from one hundred carried by the specimen examined.

The single specimen seen, a female, gives the following measurements : —

Length from tip of rostrum to tip of telson	111.0 mm.
Length of carapax, including rostrun	46.0
Length of rostrum	18.0
Breadth of carapax in front, including spines	30.0
" " at cervical suture	17.0
" " at middle, including spines	21.0
Diameter of eye	5.0
Length of antennal scale	13.1
Breadth of antennal scale	7.1
Length of external maxillipeds	27.4
" first pair of legs	27.2
" carpus	2.3
" propodus	6.2
" dactylus	3.4
" second pair of legs	right, 42.0 mm. ; left, 39.0

Length of merus	right, 8.4 mm.	left, 8.7 mm.
" carpus	" 19.9	" 17.5
" chela	" 1.2	" 1.1
" third pair of legs	41.0	
" fifth pair of legs	46.0	
" telson	20.0	

Station 326, N. Lat. 33° 42′ 15″, W. Long. 76° 0′ 50″, 464 fathoms.

Rhachocaris sculpta, sp. nov.

Plate V. Fig. 3. Plate VI. Figs. 3-3[4].

Female. — This species, though closely resembling the last in structure and general appearance, differs very conspicuously in the ornamentation of the carapax and abdomen, and in the form of the dactyli of the fourth and fifth pairs of thoracic legs. It is distinguished from *R. Agassizii* at a glance by having the dorsal and upper lateral carinæ of the carapax only obscurely indicated by lines of acute tubercles and the spaces between the carinæ tuberculous, by having two short spines each side in place of the great lateral spine of the antennal region and a small bidentate tooth in place of the sharp branchial spine of *R. Agassizii*, and in having three instead of two lateral spines on the epimeron of the fifth somite of the abdomen.

The postero-lateral angle of the carapax is more prominent and angular than in *R. Agassizii*, but in other respects the form is very nearly the same. The lateral carinæ on the posterior part of the rostrum are not so high, and the two teeth at the base of the rostrum are even smaller than the rostral teeth and are nearly erect. All the carinæ of the carapax are much less prominent, so that the carapax is more regularly rounded. The space between the two dorsal carinæ is scarcely at all depressed, the transverse sulcus at the cervical suture is not as deep, and there are two lines of small spiniform tubercles extending the whole length of the space, and the dorsal carinæ themselves are represented by two similar lines of larger spiniform tubercles with about twelve tubercles in each line, and with an obscure line of minute tubercles just outside of them. Below the dorsal carina and just back of the eye either side, at the extreme anterior end of the lateral lobe of the gastric region, there is a very large vertically compressed and acute tooth or spine connected with the lateral carina of the rostrum by a low but conspicuous ridge, just back of the base of this tooth there are one or two small spines, and on the rest of the triangular lateral lobe of the gastric region between these and the cervical suture there are approximately twelve spines or tubercles, of which those in the middle of the lobe are larger than the others. Of the three spines of the antennal region, the antennal itself is longer than in *R. Agassizii*, much stouter, considerably expanded at the base and directed strongly outward as well as forward and upward; the spine of the antero-lateral margin is stouter and directed more outward; while back of and between these spines there are two relatively small acute teeth directed

forward, one behind the other, and of which the anterior is considerably the larger, and in the space between these teeth and the gastric region there are two or three irregular lines of minute acute tubercles. Back of the cervical suture, the upper lateral carina is high, conspicuous, and marked by a line of about six acute teeth directed slightly forward, and the depression between these and the lateral carina is armed with minute spiniform tubercles obscurely arranged in longitudinal lines. The middle lateral carina is distinct, armed in front with a small bidentate tooth and back of this by a very few small and irregular teeth. The lower lateral carina is distinct, with the edge slightly crenulated but not dentate. Below the carina of the antennal region there is a longitudinal rugose ridge, and below and back of this a similar ridge on the lower part of the branchial region. The surface of the branchial region between the carinæ is roughened by many minute tubercles, the inferior margin is bordered by a conspicuous carina as in the last species, and just above this at the postero-lateral angle there is a conspicuous elongated tubercle.

The eyes are a little larger than in the last species, but do not differ in other respects. The peduncles of the antennulæ are clothed with coarser hairs than in the last species, and the distal segments are hairy above as well as on the sides, but in other respects they do not differ. The antennal scale is a little broader than in the last species and the tooth of the outer margin is more prominent and nearly half-way from the base to the tip, but the peduncle and flagellum do not differ. The distal segment of the external maxilliped is no longer than the penultimate, and the spines upon these two segments are a little more slender and the whole appendage a little shorter than in *R. Agassizii*. The legs of the first pair are a little shorter as a whole, and the propodi and dactyli are relatively shorter. The legs of the second pair are exactly as in *R. Agassizii* except that they are shorter and have fewer segments in the carpi, the right leg scarcely reaching the tip of the peduncle of the antenna, the left a little shorter, while the right carpus has twenty-three segments and the left twenty. The legs of the third pair are stouter than in *R. Agassizii* and only reach to tips of the antennal scales, but the relative lengths of the segments are about the same. The fourth and fifth pairs are proportionally short and stout, and the dactyli very different from those of *R. Agassizii*. These are alike in both pairs, about a fifth as long as the propodi, shorter than in the third pair, not at all compressed but nearly cylindrical, even slightly swollen distally, and very abruptly contracted into a bifid tip, the inner tooth of which is the longer, more acute, and curved.

The form and sculpture of the abdomen is very similar to that of the last species, but the dorsal carina on the first somite is interrupted posteriorly and on the second is not so high ; the teeth of the lateral carinæ on the first somite are not quite as acute ; the tubercles over the surface generally are more irregularly arranged, and none of them are much elongated ; the marginal spines of the epimera are shorter and less curved, but the anterior tooth on the second epimeron is much larger though obtuse ; the fifth is armed with three spiniform teeth, a median tooth, and two smaller nearly equal lateral teeth ; and the

lateral spine of the sixth somite is smaller and not directed so much backward. There are no differences of importance in the form of the telson, uropods, or other abdominal appendages.

The eggs are slightly larger than in *R. Agassizii*, and of about the same number.

The specimen above described gives the following measurements: —

Length from tip of rostrum to tip of telson	108.0 mm.
Length of carapax, including rostrum	44.0
Length of rostrum	18.5
Breadth of carapax in front, including spines	19.3
" " at cervical suture	15.4
" " at middle, including spines	21.5
Length of antennal scale	12.7
Breadth of antennal scale	6.8
Diameter of eye	5.5
Length of external maxillipeds	22.5
" first pair of legs	22.2
" second pair of legs	right, 29.0 ; left, 27.5
" merus	" 6.2 " 6.2
" carpus	" 12.7 " 11.0
" chela	" 1.1 " 1.1
" third pair of legs	34.0
" fifth pair of legs	27.5
" telson	18.5

Station 339, N. Lat. 38° 16′ 45″, W. Long. 73° 10′ 30″, 1186 fathoms.

Rhachocaris longirostris, sp. nov.

Plate V. Fig. 1. Plate VI. Fig. 1.

Female. — This species agrees with *R. Agassizii* in having the dactyli of the fourth and fifth pairs of thoracic legs slender, but in the sculpturing of the carapax and abdomen it is more like *R. sculpta*, though the tubercles are fewer in number and are all obtuse ; it differs very conspicuously from both these species in having a much longer rostrum, longer telson, much shorter antennal scales, and the eyes on shorter peduncles, and, in the alcoholic specimen, devoid of colored pigment.

The rostrum is slightly longer than the rest of the carapax along the dorsal line ; the basal two-thirds is horizontal, but the tip strongly upturned ; the upper side is flat and the horizontal portion of uniform breadth, but the tip regularly tapered and acute ; there is a slight median carina the whole length ; there are lateral spines and the corresponding pair of spines at the base of the

rostrum as in *R. sculpta*, though a little less prominent; and between the lateral spines and the curved tip the surface is irregularly corrugated. The inferior edge of the rostrum is grooved, the groove being broadest at the beginning of the curved portion, and toward the tip there is in addition a slight median carina. The carinæ of the carapax have nearly the same arrangement as in *R. sculpta*. The tubercles of the indistinct dorsal carinæ are all very low, obtuse, and punctate, and the space between the carinæ unarmed except by a few small tubercles in front. On the lateral lobes of the gastric region the tubercles are all low and obtuse, the anterior being no more prominent than the others. The antennal spine is nearly as in *R. sculpta*, but the spine of the anterior angle is shorter and stouter than in that species, and directed straight forward as in *R. Agassizii*. The lateral carina of the antennal region is continuous and terminates anteriorly in a distinct tooth back of which the edge is obtuse and punctate. Back of the cervical suture, the upper lateral carina is prominent, but the tubercles with which it is surmounted, though more prominent than the others on the carapax, are all obtuse and punctate. The middle lateral carina is continuous, broad, and punctate, and the lower carina is very low but well marked by being punctate. The inferior margin of the carapax is carinated as in the other species.

The eyestalks are very short so as to be almost entirely concealed, and the eyes themselves relatively about as broad as in the other species, but somewhat flattened anteriorly so that they appear much less prominent, and in the alcoholic specimen are perfectly white.

The peduncles of the antennulæ reach only to about the middle of the rostrum and the flagella fall short of its tip, but the proportions of both peduncles and flagella are very nearly as in the other species. The antennal scales scarcely reach to the tips of the peduncles of the antennulæ, are ovate, about three fifths as broad as long, broadest distally, and have a very indistinct tooth about the middle of the outer margin which is only obscurely ciliated back of the tooth.

The external maxillipeds and the first pair of thoracic legs are slightly shorter, reaching scarcely to the tips of the antennal scales, but otherwise as in *R. sculpta*. The thoracic legs of the second pair are similar to those of *R. sculpta*, but the right reaches a little beyond the tip of the antennal scale and its carpus has about twenty-one segments; the left is a little shorter than the right and its carpus has about eighteen segments. The third legs are nearly as in the other species, reach a little beyond the tips of the antennal scales, and their dactyli are about a third as long as the propodi and very slender. The fourth and fifth pairs of legs are but very little if at all stouter than the third, the fascicles of setæ at the tips of the propodi are nearly as long as the propodi themselves, and the propodi are slightly shorter than in the third pair, strongly compressed as in *R. Agassizii*, but slender and not expanded at all in the middle.

The sculpturing of the abdomen resembles that of *R. sculpta*, but the dorsal carina is less prominent and more obtuse, and the tubercles are fewer in num-

ber, obtuse, and punctate. The marginal spines of the epimera of the second to the fifth somite are all short, dentiform, and the posterior spine of the fifth epimeron is merely represented by an obtuse angle. The lateral spines of the sixth somite are about as prominent and fully as stout as in *R. sculpta*.

The telson is longer than the carapax along the median line, exclusive of the rostrum, and has nearly the same form and sculpturing as in *R. sculpta*, though the tip is slightly more upturned. The outer lamella of the uropod is only about two thirds as long as the telson, fully a third as broad as long, with the lateral spine farther from the tip than in the other species and the margin between the spine and the tip obliquely truncated rather than rounded. The inner lamella is narrow and considerably longer than the outer.

The specimen on which the above description is based is not carrying eggs, and the genital orifices at the bases of the third pair of thoracic legs are not easily discoverable; but the appendages of the first and second somites of the abdomen are like those of *R. sculpta*, and leave no doubt in regard to the sex.

Length from tip of rostrum to tip of telson	54.0 mm.
" of carapax including rostrum	23.0
" of rostrum	12.3
Breadth of carapax in front, including spines	8.7
" " at cervical suture	7.0
" " in middle	8.5
Length of antennal scale	4.9
Breadth of antennal scale	3.0
Diameter of eye	2.5
Length of telson	11.0

Station 330, N. Lat. 31° 41′, W. Long. 74° 35′, 1047 fathoms.

From Station 315, N. Lat. 32° 18′ 20″, W. Long. 78° 43′, 252 fathoms, there is a single small and imperfect specimen, evidently the young of this species. This specimen is about 25 mm. long and differs from the one above described in having the carinæ of the carapax a little sharper; the lateral carina of the antennal region interrupted in the middle; the marginal teeth of the abdominal epimera smaller in proportion and the posterior tooth of the fifth epimeron wholly wanting, leaving it bidentate like the third and fourth; and the right and left carpi in the second pair of thoracic legs of about eighteen and fifteen segments respectively.

PALÆMONIDÆ.

ALPHEINÆ.

Hippolyte Liljeborgii Danielssen.

Hippolyte Liljeborgii Danielssen, Nyt Magazin Naturv., Christiania, XI. p. 5, 1861.
Metzger, Jahresber. Comm. wissensch. Untersuchung deutschen Meere, 1872–73, Nordsee, p. 290, 1865 (*Lilljeborgi*).
Danielssen and Boeck, Nyt Magazin Naturv., Christiania, XIX. p. 196, Pl., figs. 15–20, 1872.
Hippolyte securifrons Norman, Trans. Tyneside Naturalists' Field Club, V. p. 267, 1863 (teste Danielssen and Boeck, Metzger).
Smith, Trans. Conn. Acad., V. p. 69, Pl. X. fig. 3, 1879; Proc. National Mus., Washington, III. p. 437, 1881.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
303	41° 34′ 30″	65° 54′ 30″	306	8 ♀
306	41° 32′ 50″	65° 55′ 0″	524	2 ♀
309	40° 11′ 40″	68° 22′ 0″	304	2 ♀

This species appears to be abundant in deep water off the whole New England coast. It has also been taken off the Capes of the Delaware by Capt. Z. L. Tanner, of the U. S. Fish Commission Steamer "Fish-Hawk," Station 1045, N. L. 38° 35′, W. Long. 73° 13′, 312 fathoms, and at neighboring stations.

Hippolyte Phippsii Kröyer.

Hippolyte Phippsii Kröyer, Naturh. Tidssk., III. p. 575, 1841 (♂).
Hippolyte turgida Kröyer, Ibid., p. 575, 1841 (♀).
Hippolyte vibrans Stimpson, Ann. Lyceum Nat. Hist. New York, X. p. 125 (♂, var.).
Hippolyte Ochotensis Brandt, Middendorff's Sibirische Reise, II. p. 120, Pl. V. fig. 17, 1849 (♀).

Station 302, N. Lat. 41° 30′, W. Long. 66° 3′, 73 fathoms : one male.

Hippolyte polaris Ross.

Alpheus polaris Sabine, Suppl. to Appendix of Parry's First Voyage, p. ccxxxviii. Pl. II. figs. 5–8, 1824.
Hippolyte polaris J. C. Ross, in John Ross, Appendix to Second Voyage, p. lxxxv., 1835 (♀).
Hippolyte borealis J. C. Ross, in John Ross, *op. cit.*, p. lxxxiv. Pl. B, fig. 3, 1835 (♂).

Station 303, N. Lat. 41° 34′ 30″, W. Long. 65° 54′ 30″, 306 fathoms; one male.

Caridion Gordoni Goës.

Hippolyte Gordoni Bate, Nat. Hist. Review, V., Proc., p. 51, figs., 1858. [No specific name is given in the article, though the species is said to be named after its discoverer, the Rev. G. Gordon, but *Hippolyte Gordoni* is given in the "Index to the Proceedings," p. iv.]

Doryphorus Gordoni Norman, Ann. Mag. Nat. Hist., 3d Series, VIII. p. 277, Pl. XIII. figs. 6, 7, 1861. [The generic name preoccupied.]

Caridion Gordoni Goës, Öfversigt Vetenskaps-Akad. Förhandlingar, Stockholm, 1863, p. 170 (10).

Station 311, N. Lat. 39° 59′ 30″, W. Long. 70° 12′, 143 fathoms, sand; two specimens, male and female.

Bythocaris, sp. indet.

A few specimens from Station 314, N. Lat. 32° 24′, W. Long. 78° 44′, 142 fathoms; and Station 327, N. Lat. 34° 0′ 30″, W. Lon. 76° 10′ 30″, 178 fathoms.

The species is the same as the one I have referred to as taken off Block Island by the U. S. Fish Commission (Proc. National Mus., Washington, III. p. 437, 1881). It is apparently closely allied to *B. Payeri* G. O. Sars (Archiv Mathem. Naturvid. Kristiania, II. p. 340, 1877, *Hippolyte Payeri* Heller), but the specimens are all much smaller thon the one described by Heller, none of them being over 30 mm. in length, and probably belong to a distinct species.

Anchistia tenella, sp. nov.

Plate IX. Figs. 1 - 1b.

This species is represented by a single specimen, an egg-carrying female. The integument is very thin and soft, so that it is difficult to make out accurately the proportions of the carapax, which is apparently slightly compressed laterally. The rostrum is slender, falls slightly short of the tips of the antennal scales, is fully three fourths as long as the rest of the carapax along the dorsal line; the dorsal crest extends back a short distance upon the carapax, is directed slightly downward through its whole length, and is armed with nine teeth, crowded posteriorly but more widely separated anteriorly, and of which three are back of the orbit and the small anterior one near the acute tip; the lower edge is armed with three teeth. The anterior margin projects in an acute angle below the orbit, and there are well-developed antennal and hepatic spines. Just back of the dorsal crest there is a slight notch in the dorsum with a distinct but short transverse sulcus turned forward either side.

The eyes are small, black, and fall considerably short of the middle of the rostrum. The peduncle of the antennula (Pl. IX. fig. 1a) reaches to the tip of

the rostrum: the first segment is squamiform, about once and two thirds as long as the two distal segments together, about three sevenths as broad as long, and the outer margin is armed with an acute tooth near the middle and projects distally in a similar tooth half as long as the second segment; the second and third segments are subequal in length, the second less than half as wide as the first but with a slight carina-like expansion on the outer side, while the third is still narrower and nearly cylindrical. The outer flagellum is divided for nearly half the length of the outer portion, which is as long as the peduncle, rather stout and somewhat hairy, while the inner ramus is more slender, nearly naked, and extends more than half the length of the whole flagellum beyond the tip of the outer ramus. The inner flagellum is very slender and apparently a little shorter than the outer, but is imperfect at the tip. The antennal scale (Fig. 1[b]) is about as long as the rostrum, more than a third as broad as long, only very slightly narrowed distally, and the broad obliquely truncated and rounded tip extends considerably beyond the large and acute spine in which the outer margin terminates. The terminal segment of the peduncle is slender and about two fifths as long as the scale. The flagellum is nearly as long as the whole body of the animal.

The external maxillipeds reach to the middle of the antennal scales and are very slender; the first of the three segments of the endopod reaches to the front edge of the carapax, and the second and third are successively a little shorter. The exopod is slender and reaches a little by the first segment of the endopod. The two pairs of chelate legs are unsymmetrical, the legs of the left side being larger than those of the right. This is very likely accidental, however, for the right antennal scale is short and misshapen, evidently reproduced after injury, and the right chelate legs have very likely been reproduced also, although they are as well formed as the left ones. The left leg of the first pair is about as long as the carapax including the rostrum; the merus and carpus slender and subequal in length; the chela nearly as long as the carpus, and slender, six or seven times as long as broad and with slender and slightly curved digits nearly half the whole length. The right leg is slightly smaller than the left, but the proportion of the parts the same. The left leg of the second pair is once and a half as long as that of the first pair; the ischium and merus are subequal in length, the latter reaching as far forward as the tip of the rostrum; the carpus is a little more than half as long as the merus, and shorter than in the first pair; the chela is nearly as long as the carpus and merus together, slender, though slightly swollen in the middle, and with slender digits about two fifths the whole length. The right leg is about a fourth shorter than the left, and slender in proportion. The third and fourth pairs of legs are alike, slender, about a third longer than the carapax including the rostrum, the carpi about two thirds as long as the meri, the propodi considerably longer than the carpi, and the dactyli slender, slightly curved, acute, and only a sixth or seventh as long as the propodi.

The epimeron of the first somite of the abdomen is very broad, but little narrower than that of the second, and extends far forward by the posterior edge

of the carapax; the second epimeron is orbicular, broader than high and nearly as broad as the whole height of the somite; the third epimeron is broad and rounded posteriorly; the fourth epimeron is prolonged backward nearly the full length of the fifth somite and is evenly rounded posteriorly; the fifth is rounded and projects very slightly posteriorly. The sixth somite is nearly twice as long as the fifth, and about half as high as long. The telson is nearly a third longer than the sixth somite, thin and lamellar, tapers regularly to a rounded tip unsymmetrically armed with five spines and perhaps not quite perfect, and above is evenly rounded and armed with two pairs of aculei. The lamellæ of the uropods reach a little by the tip of the telson: the inner is narrowly ovate and nearly four times as long as broad; the outer is less than three times as long as broad, and broadly rounded at the tip, which projects much beyond the tooth in which the thickened outer margin terminates.

The eggs, which are well advanced toward maturity, are approximately 0.60 and 0.45 mm. in greater and less diameter in the alcoholic specimen.

All the oral appendages agree very closely with those of *Palæmonetes varians* (Leach sp.) and the number and arrangement of the branchiæ are apparently the same as in that species, though I am not certain that there is more than one arthrobranchia at the base of the external maxilliped. [*Palæmonetes varians* and *Leander natator* have the same branchial formula as *Palæmon squilla.*]

The single specimen is from Station 316, N. Lat. 32 7′, W. Long. 78° 37′ 30″, 229 fathoms, bottom of pebbles, and gives the following measurements: —

Sex		♀
Length from tip of rostrum to tip of telson		25.0 mm.
" of carapax including rostrum		9.3
" of rostrum		3.8
" of antennal scale		3.7
Breadth of " "		1.4
Length of first pair of legs	right, 8.9 ; left,	9.5
" chela	" 1.8 "	2.0
" second pair of legs	" 11.5 "	15.0
" ischium	" 2.4 "	3.1
" merus	" 2.5 "	3.3
" carpus	" 1.5 "	1.8
" chela	" 3.7 "	5.0
" dactylus	" 1.5 "	2.0
" third pair of legs		12.5
" propodus		3.5
" dactylus		0.5
" sixth somite of abdomen		3.0
Height of " " "		1.5
Length of telson		4.3

PANDALINÆ.

Pandalus propinquus G. O. Sars.

G. O. Sars, Vidensk.-Selsk. Forhandl. Christiania, 1869, p. 148 (4); Ibid., 1871, p. 259 (16).
Smith, Proc. National Mus., Washington, III. p. 437, 1881.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
306	41° 32′ 50″	65° 55′ 0″	524	2
309	40° 11′ 40″	68° 22′ 0″	304	12

This species is not uncommon in deep water off the New England coast, and is found at least as far south as off the Capes of the Delaware, where it has been taken in abundance by Capt. Z. L. Tanner, of the U. S. Fish Commission steamer "Fish-Hawk," Station 1045, N. Lat. 38° 35′, W. Long. 73° 13′, 312 fathoms.

Pandalus leptocerus Smith.

Proc. National Mus., Washington, III. p. 437, 1881.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
301	41° 26′ 55″	66° 3′ 0″	71	2
302	41° 30′ 0″	66° 0′ 0″	73	7
303	41° 34′ 30″	65° 54′ 30″	306	25±
304	41° 35′ 0″	65° 57′ 30″	139	1
311	39° 59′ 30″	70° 12′ 0″	143	14
344	40° 1′ 0″	70° 58′ 0″	129	2
346	40° 25′ 35″	71° 10′ 30″	44	1

This species almost entirely replaces *P. Montagui* south of Cape Cod, and appears to be everywhere exceedingly abundant in from 30 to 200 fathoms, but below 300 fathoms it seems to give place to *P. propinquus*.

In size and general appearance it is much like *P. Montagui* but more slender and readily distinguished from it, and from *P. propinquus* and *borealis* as well, by the minutely roughened surface and the presence of exopods upon the external maxillipeds.

The rostrum is from about once and a third to nearly twice as long as the rest of the carapax, and curved very slightly upward, but usually not as much so as in *P. Montagui*. Above, it is armed with eleven to thirteen teeth, of which one is near the tip, as in *P. Montagui*, and usually only two back of the orbit on the carapax proper, while a considerable space back of the terminal spine is unarmed, though this space is usually shorter than in *P. Montagui*. Beneath, there are six to eight teeth, as in *P. Montagui*. The entire surface of the carapax and abdomen is slightly roughened with short and irregular, trans-

verse punctate ridges, which give rise to very short bristle-like hairs, while in *P. Montagui*, *propinquus*, and *borealis* the surface is naked and very smooth. The carapax is considerably more slender than in *P. Montagui*, and the posterior tooth of the dorsal carina is farther forward, being much in front of the middle. The abdomen is more slender than in *P. Montagui;* but, except for the greater slenderness, there is scarcely any difference in the form or proportions of the somites, or the form and armature of the telson and uropods. There are slender exopods, about a third as long as the ischia, at the bases of the external maxillipeds, but the endopods themselves are as in *P. Montagui;* the merus reaches to the base of the flagellum of the antenna, and the tip falls considerably short of the tip of the antennal scale.

The legs of the first pair are nearly as in *P. Montagui.* The right chelate leg of the second pair is shorter and stouter than in *P. Montagui*, and scarcely reaches the tip of the corresponding leg of the first pair ; the ischium is about a fourth the entire length ; the merus is only a little shorter than the ischium ; the carpus increases in thickness distally, is a little longer than the ischium, not more than about once and a half as long as the merus, and usually composed of only five segments, the proximal half being wholly unsegmented or annulated, then three subequal and very distinct segments, about as broad as long, and these followed by the terminal segment, which is about as long as the three next preceding ; the chela is about half as long as the carpus, and a little stouter than its distal end. The left chelate leg is a little shorter and stouter than in *P. Montagui*, but has about the same number of segments in the merus and carpus, and does not differ in other respects. The third, fourth, and fifth pairs of legs differ from those of *P. Montagui* in being a little more slender, and in having much longer, much more slender, and nearly cylindrical dactyli, which are wholly unarmed, except a few small spinules beneath near the base.

The branchial formula is the same as in *P. Montagui.*

Pandalus tenuipes Smith.

Proc. National Mus., Washington, III. p. 441, 1881.

Plate XIII. Fig. 12.

Station 314, N. Lat. 32° 24′, W. Long. 78° 44′, 142 fathoms ; one male and one young specimen, both imperfect.

This species is smaller but has a proportionally thicker body than *P. Montagui*, and the surface of the carapax and abdomen is very minutely roughened, somewhat as in *P. leptocerus*, but the punctate ridges are much less conspicuous and much more thickly crowded than in that species.

The carapax, including the rostrum, is about two fifths of the entire length, and the carapax proper is nearly as long as the rostrum, slightly swollen in the middle, somewhat contracted in front, as seen from above, and with the rostral carina extending back to about the middle, and armed, at about a third of the

way from the orbit to the posterior margin, with two to four slender spines crowded close together, rapidly decreasing in size posteriorly and *movably articulated* with the carapax ; but between these teeth and the posterior teeth of the rostrum the carina is wholly unarmed. The rostrum is curved upward a little more than in *P. Montagui*, is not expanded below, and is armed the whole length above with eight to ten teeth, which are usually more widely separated distally, though in some specimens the terminal two or three are crowded together near the tip ; beneath there are six to ten small teeth.

The eyes are black and as broad as long, but shorter than in *P. Montagui*. The peduncle of the antennula reaches to near the middle of the antennal scale, and the two distal segments are subequal in length and each about as broad as long. The antennular flagella are subequal in length and much longer than the carapax, including the rostrum ; the proximal half of the outer flagellum is very much thickened, the terminal portion very slender, as is the inner flagellum throughout. The antennal scale is approximately four fifths as long as the rostrum, and of very nearly the same form as in *P. Montagui*. The oral appendages differ from those of *P. Montagui* in the following particulars : the proximal segment of the mandibular palpus is dilated, though not quite as conspicuously as in *P. Montagui ;* the posterior lobe of the scaphognath of the second maxilla is very short, broad, obtusely rounded at the extremity, and projects very little back of the base of the endognath, while in *P. Montagui* and the allied species it is very much prolonged and acutely triangular posteriorly ; in the second maxilliped the dactylus is about as long as broad, and articulated with the oblique distal end of the propodus (Pl. XIII. fig. 12), while in *P. Montagui* and its allies the dactylus is a narrow plate, articulated by one edge to the distal part of the mesial edge of the propodus. The external maxillipeds are very slender, reach to about the tip of the rostrum, and have well-developed exopods, fully half as long as the ischium ; the ischium is a little longer than the rest of the endopod, which is composed, as in *P. Montagui*, of only two distinct segments beyond the ischium, and in this case these two segments are subequal in length.

The legs of the first pair are very slender, and reach to the tips of the external maxillipeds. The second (chelate) legs are exactly alike, and reach to or considerably by the tips of the antennal scales. The ischium is a little longer than the merus ; the carpus is a little less than twice as long as the merus, slightly shorter than the antennal scale, and composed of about fifteen segments, of which the proximal are separated by indistinct, but the four or five distal by conspicuous articulations, while the ultimate is about twice as long as broad, and the next three or four, each, only about half as long as broad. The chela is slender, only a very little stouter than the distal end of the carpus, nearly a third as long as the carpus, and about half as long as the merus, and the digits are alike, about as long as the basal portion, slightly gaping, and with a very few long, setiform hairs. The third, fourth, and fifth pairs of legs are exceedingly slender, sparsely armed with minute spinules and slender setæ ; and the dactyli are very long and slender, slightly and regularly bent, and

flattened a little vertically (or in the direction of the plane of the curvature), and wholly unarmed; those of the fifth pair reach beyond the tip of the rostrum, and the fourth and third pairs are successively a little longer; the dactylus in the fifth pair is a third or a little more than a third as long as the propodus, in the fourth pair a little longer than in the fifth, and in the third pair not far from half as long as the propodus.

The abdomen is evenly rounded and not at all compressed above, and less geniculated at the third segment than in *P. Montagui*. The sixth segment is about once and two thirds as long as the fifth. The telson is about once and a half as long as the sixth segment, and terminates in an acutely triangular tip, armed each side with two long spines, of which the proximal is very much the longer, and at the extreme tip with a few long, plumose setæ.

The branchial formula is the same as in *P. Montagui*.

Pandalus acanthonotus, sp. nov.

Plate XIII. Figs. 10, 11.

This species, of which there is but one specimen in the collection, is closely allied to *P. tenuipes*, but is at once distinguished from it by the deeper and nearly horizontal rostrum with the dorsal teeth forming a continuous series with the spines on the dorsal crest of the carapax; and by the much longer sixth somite of the abdomen, which is more than twice as long as the fifth somite, and longer even than the telson.

Female. — The carapax including the rostrum is only about a third of the entire length, somewhat contracted in front as seen from above, and with the rostral carina extending back to about the middle, but not sharp except in front, where it is armed with five slender spines *movably articulated* with the carapax and closely crowded together. The rostrum is considerably shorter than the carapax proper, nearly horizontal, expanded below, tapers to an acute tip, is armed above with seven teeth, of which the anterior is very minute and a little way from the tip while posteriorly the teeth become slender and at last spiniform, almost like the spines of the carapax, with which they form a continuous series; below, the edge is armed with six teeth, of which the anterior one is minute and situated a little back of the tip.

The eyes are large, pyriform, and black, and, as well as the antennulæ and antennæ, are nearly as in *P. tenuipes*.

The oral appendages are all very nearly as in *P. tenuipes;* the propodus in the second maxilliped (Pl. XIII. fig. 11) is, however, a little larger proportionally, and the very narrow dactylus articulated along nearly half the length of the mesial edge of the propodus very much as in *P. Montagui*, while in *P. tenuipes* the dactylus is about half as long as broad and articulated with the oblique distal end of the propodus. The external maxillipeds reach a little by the tips of the antennal scales, are almost exactly as in *P. tenuipes*, and, as in that species, have well developed exopods half as long as the ischia. The oral

appendages do not differ very much from those of *P. carinatus* figured on Plates X. and XI.: the first maxillæ and second maxillipeds are almost exactly as in *P. carinatus;* the distal segment of the mandibular palpus is broader and more obtuse at the tip, but in other respects the mandibles do not differ; the second maxillæ differ only in having the posterior division of the distal lobe of the protognath proportionally a little smaller; the first maxillipeds are similar to those of *P. carinatus*, but the lamellar portion of the exopod is a little broader and more abruptly narrowed into a more slender flagelliform portion; the external maxillipeds are more slender than in *P. carinatus*, and the two distal segments are subequal in length.

The legs of the first pair reach to the tips of the external maxillipeds and are as in *P. tenuipes*. The second (chelate) legs are very nearly alike, but the left is a little longer than the right and reaches to about the tip of the antennal scale; both are about equally slender; the carpi are more than a third of the entire length, segmented throughout but more conspicuously distally, and composed of about twenty segments, of which the most distal one is considerably longer than broad, but all the others shorter than this and approximately equal in length; the chelæ are alike, scarcely stouter than the carpus and only a little more than twice as long as its distal segment. The third, fourth, and fifth pairs of legs are nearly as in *P. tenuipes:* those of the posterior pair reach considerably by the tip of the rostrum, and the fourth and third are successively a little longer; the meri are sparsely armed with small spines, but the distal segments unarmed excepting a few setæ or hairs; the dactylus in the third pair is about a third as long as the propodus, and in the fourth pair about a fourth as long as the propodus.

The abdomen is rounded above, but is rather strongly geniculated and slightly compressed at the third somite. The sixth somite is more than twice as long as the fifth, longer even than the antennal scale or rostrum, and strongly compressed.

The telson is much shorter than the sixth somite, slender, and terminates, as in *P. tenuipes*, in a triangular tip armed each side with two long and slender spines of which the proximal is much the longer.

The surface of the carapax and abdomen is minutely roughened, as in *P. tenuipes*, by thickly crowded irregular transverse punctate ridges.

The branchial formula is apparently just as in *P. tenuipes*, *P. Montagui*, etc., and as in the following species, *P. carinatus*.

MEASUREMENTS.

Station	321
Sex	♀
Length from tip of rostrum to tip of telson	42.0 mm.
" of carapax including rostrum	14.2
" of rostrum	6.3
Breadth of carapax	4.9
Length of antennal scale	5.6

Breadth of antennal scale	1.3 mm.
Length of right chelate leg	11.5
" carpus	4.2
" chela	1.0
" left chelate leg	13.5
" carpus	5.4
" chela	1.0
" third leg	19.0
" fifth leg	18.5
" fifth somite of abdomen	3.0
" sixth somite of abdomen	7.0
Height of " " "	2.7
Length of telson	5.2

Station 321, N. Lat. 32° 43′ 25″, W. Long. 77° 20′ 30″, 233 fathoms.

Pandalus carinatus, sp. nov.

Plate X. Figs. 2-2ᶜ. Plate XI. Figs. 1-3.

Female. — The surface of the carapax and abdomen is microscopically punctate for the insertion of very minute hairs. The carapax including the rostrum is about as long as the entire abdomen, but the carapax proper much shorter than the rostrum and armed with a high dorsal crest nearly the whole length and with four sharp and very conspicuous longitudinal carinæ each side. The rostrum is very slender, nearly horizontal toward the base and slightly upturned from a little back of the middle, and armed above, from near the slender and acute tip, with thirteen conspicuous teeth in front of the orbit and four more on the anterior half of the carapax, and beneath from near the tip to the front of the eye with nine similar teeth. The uppermost of the four lateral carinæ is in a line straight back from the middle of the orbit, but is interrupted by a slight depression and terminates in a small tooth just back of the middle, and is not conspicuous on the anterior half of the carapax; the second and third carinæ are continuous the whole length of the carapax, nearly parallel and slightly curved, the upper terminating anteriorly in a conspicuous antennal spine just over the base of the antenna, the lower in a similar but laterally more prominent spine below the base of the antenna; the lowest carina is a marginal carina of the inferior edge of the carapax, which is more strongly incurved than in the typical species of *Pandalus*.

The eyes are rather small for the genus, pyriform, and black. The first segment of the peduncle of the antennula is broad, squamiform, excavated for the reception of the eye, and furnished externally with a large lamellar process terminating anteriorly in an acute angle in front of the eye. The second and third segments are very short, taken together being scarcely longer than their diameter. The outer flagellum is a little more than twice as long as the peduncle, the basal half considerably thickened and hairy, but the terminal

portion exceedingly slender. The inner flagellum is considerably longer than the outer, reaches nearly to the tip of the rostrum, and is slender throughout. The antennal scale is about three fourths as long as the carapax excluding the rostrum, and near the base about a fourth as broad as long, but tapers distally to an acute tip. The second segment of the peduncle of the antenna is armed with a triangular tooth above the base of the scale and with a long spine below. The flagellum is slender, and considerably longer than the carapax including the rostrum.

The mandibles (Pl. XI. fig. 1) are nearly as in *P. Montagui*, though the proximal segment of the palpus is much less dilated, and all the segments are only sparsely armed with setæ ; the mandibles are in fact more nearly as in *P. tenuipes*. The first maxillæ (Fig. 2) are essentially as in *P. Montagui*. The lobes of the protognath and the endognath of the second maxilla (Fig. 3) are nearly as in *P. Montagui*, but the scapognath is very different ; its posterior lobe is short, broad, and evenly rounded, much as in *P. tenuipes*, while the anterior lobe is much longer than the posterior, fully as broad, and with a broad and truncated extremity ; both extremities of the scaphognath are margined with very long plumose setæ, while those upon the edges between are short. The first and second maxillipeds (Pl. X. figs. 2^a, 2^b) do not differ essentially from those of *P. Montagui*. The external maxillipeds have well-developed exopods about two thirds as long as the ischium, which is more than half the entire length of the endopod ; the terminal segment of the endopod is considerably longer than the penultimate, and tapers to an acute point.

The legs of the first pair are more slender than the external maxillipeds, and do not quite reach to their tips. The right chelate leg (Pl. X. fig. 2^c) reaches a little by the base of the antennal scale, and is rather stouter than usual in the genus ; the merus and carpus are subequal in length, and the carpus is rather obscurely divided into about eight segments, of which the proximal and distal are much longer than the others ; the chela is very little shorter than the carpus and much stouter, and somewhat swollen so that it is between a third and a fourth as broad as long ; the digits are rather stout, slightly curved, and more than a third of the entire length.

The three last pairs of legs are slender, subequal in length, reach to about the tips of the first pair, are armed with numerous setæ and slender spines, and the dactyli are slender, very slightly curved, and about a third as long as the propodi.

The first, second, fifth, and sixth somites of the abdomen are evenly rounded above, but the third and fourth are armed with a sharp dorsal carina, most conspicuous on the third somite, and in both somites projecting backward over the succeeding somite in a prominent horizontal and acute tooth. The first epimeron projects downward even below the second, which is orbicular and about as broad as high ; the third and fourth epimera project backward in evenly rounded lobes, but the fifth in an acute angle.

The telson is about as long as the fifth and sixth somites together, narrow, armed with four pairs of dorsal aculei, and the triangular tip (Pl. X. fig. 2^f)

with three pairs of spines, of which the terminal are small and slender, the next very long, and the anterior short and stout. The lamellæ of the uropods are about as long as the telson : the inner is lanceolate and between four and five times as long as broad ; the outer is between three and four times as long as broad, with the tip broad, somewhat obliquely rounded, and projecting considerably beyond the acute tooth in which the outer margin terminates, and just inside the base of which there is a spine much longer than the tooth itself.

The outer lamella of the appendage of the first somite of the abdomen is a little longer than the protopod, about a sixth as broad as long, and margined with multiarticulate plumose setæ as usual, while the inner lamella is a little less than half as long as the outer, expanded externally near the base, where the breadth is equal to about a fourth the length, but tapering and slender distally, and margined with plumose setæ like the outer. The inner lamella of the appendage of the second somite is a little longer than the outer lamella of the appendage of the first somite, between six and seven times as long as broad, and bears, a little way from the base, the usual stylet, which is about a fifth as long as the lamella itself.

The single specimen is from Station 327, N. Lat. 34° 0′ 30″, W. Lon. 76° 10′ 30″, 178 fathoms, and gives the following measurements : —

Sex	♀
Length from tip of rostrum to tip of telson	48.0 mm.
" of carapax including rostrum	24.0
" of rostrum	15.2
Breadth of carapax	5.2
Length of antennal scale	7.1
Breadth of " "	1.8
Length of right chelate leg	9.2
" carpus	2.2
" chela	1.9
" left chelate leg	12.3
" carpus	4.8
" chela	1.2
" sixth somite of abdomen	4.3
Height of " " "	2.2
Length of telson	6.1

The genus *Pandalus*, as at present recognized, apparently contains species representing several genera, and this species is probably not strictly congeneric with *P. Montagui*, the type species. The carinated carapax gives the species a very different aspect from the typical *Pandali*, but the appendages throughout, excepting the scaphognath of the second maxilla, are very nearly as in *P. Montagui*, and the number and arrangement of the branchiæ are the same as in that species, *P. propinquus*, *borealis*, *leptocerus*, and *tenuipes*, or as indicated in the following formula.

Somites.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.	Total.
Epipods,	1	1	1	1	1	1	1	0	(7)
Podobranchiæ,	0	1	0	0	0	0	0	0	1
Arthrobranchiæ,	0	0	2	1	1	1	1	0	6
Pleurobranchiæ,	0	0	0	1	1	1	1	1	5
									12+(7)

This species will evidently fall in Milne-Edwards's genus *Heterocarpus* (Ann. Sci. Nat., 6me series, XI. No. 4, p. 8, 1881), of which the description has been published since the above was written, and it appears to be closely allied to, but distinct from, his *H. ensifer*, from 218 fathoms near Barbadoes. Milne-Edwards has however misapprehended the affinities of the genus, of which he says: "Les crustacés du genre *Heterocarpus* offrent certaines analogies avec les Oplophorus et, par d'autres caractères, ils se rapprochent des Lysmates, des Hippolytes et des autres crustacés de la même famille." The genus is very near *Pandalus*, certainly far nearer than to *Oplophorus* (of which, however, I have never examined specimens), or any other described genus. *Heterocarpus* should be placed with the two or three genera into which the genus *Pandalus* as it now stands must sooner or later be divided, and the species which I have here described should then stand as *Heterocarpus carinatus*.

EPHYRINÆ.

MIERSIA Kingsley.

Ephyra Roux (nom. præoc.).

As far as I know, the only described species properly referred to this genus are *M. pelagica* and *punctulata* (Risso sp.), both apparently unknown to modern carcinologists, and *M. Hœckelii* (*Ephyra Hœckelii* Von Martens), all from the Mediterranean. *Ephyra compressa* De Haan, placed in *Miersia* by Kingsley, had already been referred to *Atyephyra* by Von Martens (Archiv fur Naturgesch., XXXIV., 1868, p. 51, Pl. I. fig. 4a to 4c), and is certainly not closely allied to the species here described nor to *M. Hœckelii*.

A new genus, *Meningodora*, described beyond, and *Hymenodora* G. O. Sars, are in most characters closely allied to *Miersia*, and are here referred to the same subfamily, which has little affinity with the Atyidæ, but is in many respects much like *Pandalus*, and has, perhaps, still closer affinity with *Oplophorus* or some of its allies.

Eumiersia, a new genus described beyond, is in some respects intermediate between the genera just mentioned and *Pandalus*, and is only provisionally placed in this subfamily.

Miersia Agassizii, sp. nov.

Plate XI. Figs. 5-7. Plate XII. Figs. 1-4.

Male. — The carapax is nearly as broad as high, but is a little compressed above so as to make the dorsum somewhat obtusely angular, though rounded and not at all carinate even anteriorly. The rostrum is imperfect in all the specimens seen, but in the most perfect specimen it was evidently much longer than the carapax proper ; it is very slender, slightly upturned toward the tip, and back of the tip of the antennal scale is armed with seven teeth above and four beneath. The anterior margin projects in an acute, but scarcely spiniform, angle above the base of the antenna, and opposite the base in an acute and laterally prominent branchiostegial spine, below which the branchiostergite is rather suddenly incurved in the anterior part of the carapax. The surface of the carapax and abdomen is naked and smooth to the unaided eye, but is microscopically punctate.

The eyestalks are very short, and terminated by small hemispherical black eyes. The peduncle of the antennula is short, much less than half as long as the antennal scale : the first segment is fully as long as the second and third taken together, is deeply excavated above for the reception of the eye, and its outer edge is armed distally with a small tooth ; the second and third segments are broader than long and subcylindrical. The outer or major flagellum is nearly twice as long as the antennal scale, with the proximal portion for about half the length of the antennal scale compressed vertically, broadly expanded, and thickly clothed beneath with fine hairs, but the distal portion is very slender and somewhat compressed vertically. The antennal scale is about three fourths as long as the carapax excluding the rostrum, and near the base about a fourth as broad as long, but narrowed regularly to a very slender tip. The second segment of the peduncle is armed with an acute dentiform spine below, and a triangular tooth above the base of the scale. The distal segment of the peduncle reaches only about a third of the way from the base to the tip of the antennal scale. The flagellum is wanting in all the specimens examined.

The labrum is fleshy, prominent as seen in front, and the inferior edge is thickened and slightly indurated and applied to the concave dorsal surfaces of the mandibles. The lobes of the metastome are very broad distally and somewhat truncated. The mandibles (Pl. XII. figs. 1, 1ª) are expanded into thin, dorsally concave and strongly dentate ventral processes, above and closely connected with which are small and narrow molar areas. The opposing edges of the ventral processes differ somewhat on the two sides : on the right side, as shown in the figures, the mesial edge is slightly convex as seen from above or below, and armed with about eight acutely triangular teeth, beyond which there are several small teeth on the anterior edge ; on the left side the mesial edge as seen from above or below is straight or slightly concave, terminates anteriorly in a sharp angle beyond which there are no teeth on the anterior edge, and the

teeth on the anterior part of the mesial edge are very small, though back of these small teeth there are about as many and as large teeth as on the mesial edge of the right mandible. The protognathal lobes of the first maxilla (Pl. XII. fig. 2) are approximately equal in size, broad at the ends, and armed as usual with slender spines upon the distal, and numerous setæ upon the proximal lobe. The endognath is small, obtusely pointed, and armed with a very few marginal setæ and with two slender spines upon a small fold on the ventral side near the tip. The protognathal lobes of the second maxilla (Pl. XII. fig. 3) are very unequal, the proximal lobe is broad but very short, while the distal is long and deeply divided into two narrow and obtuse lobes. The endognath is unsegmented, short, and narrowed to a slender tip. The scaphognath projects anteriorly slightly beyond the endognath, and both ends are broad and evenly rounded.

The protopod of the first maxilliped (Pl. XII. fig. 4) projects very little anteriorly, and is obscurely divided into a very small proximal and a large distal lobe. The endopod is well developed, and composed of three segments, of which the proximal is very short, broader than long, the second nearly three times as long as broad, the terminal a little smaller than the second and lanceolately pointed, and all the segments margined with setæ. The exopod is a very large lamelliform lobe longer than the endopod, about a third as broad as long, expanded and broadly rounded in outline distally, and edged with plumose setæ which gradually increase in size distally along the margin. The epipod is small, branchial, with the anterior and posterior parts nearly equal. The ischium in the second maxilliped (Pl. XI. fig. 5ª) is much shorter than broad ; the merus between two and three times as long as broad ; the carpus a little narrower than the merus and about as long as broad ; the propodus bent back upon the merus as in most Palæmonidæ, a little longer than the merus, nearly half as broad as long, and obliquely truncated along the mesial edge for the articulation of the dactylus, which is more than twice as broad as long and armed with setæ and slender spines as is the mesial and anterior edge of the dactylus. The exopod is nearly as long as the endopod, slender, and multiarticulate and flagelliform for more than half its length. The epipod is broad at base, somewhat triangular, and bears a large phillobranchia. The endopod of the external maxilliped reaches a little beyond the middle of the antennal scale, and is slender and composed of three segments, of which the proximal is the longest, reaches as far forward as the antero-lateral angle of the carapax, and is strongly curved and dorsally compressed in the middle opposite the mouth ; the middle and the distal segments are straight, the middle about half as long, and the distal nearly as long, as the proximal ; all the segments are more or less setigerous. The exopod is slender, multiarticulate, flagelliform, and about as long as the proximal segment of the endopod. The epipod is narrow, lamellar, nearly as long as the middle segment of the endopod, and lies between the branchiæ of the ninth and tenth somites.

All the thoracic legs are furnished with exopods like those of the external maxillipeds, and the first, second, and third pairs are furnished also with epi-

pods like those of the external maxillipeds. The first and second pairs of legs are slender, do not reach the tips of the external maxillipeds, and are very nearly alike, but the carpus and chela are a little longer and more slender in the second than in the first pair. In both pairs the merus is a little longer than the ischium, and reaches to or a little by the antero-lateral angle of the carapax. In the first pair the carpus is scarcely more than half as long and about as stout as the merus, and the chela is somewhat longer and a little stouter than the carpus, and with slender slightly compressed and nearly straight digits about a third of the whole length. In the second pair the carpus is scarcely as stout as the merus and about two thirds as long, and the chela is scarcely stouter than the carpus, but considerably longer. The third and fourth pairs of legs are nearly alike and reach by the tips of the external maxillipeds, the lower edges of the meri are spinulose, the propodi considerably longer than the carpi, and the dactyli are slender, nearly straight, unarmed, and nearly a third as long as the propodi. The posterior legs are slightly shorter than the third and fourth, and like them except the distal extremity, which is peculiarly modified. The propodus is slender, about as long as in the third and fourth pairs, is furnished with a few very long plumose setæ near the middle, is thickly armed distally along the lower edge with serrately armed and simple setæ, and so densely clothed at the tip with long setæ as to very nearly hide the dactylus, which is very short, curved at the tip, and armed with several slender spines.

The abdomen is large relatively to the cephalo-thorax, strongly compressed, and dorsally carinated except upon the first somite, the carina being most conspicuous on the third somite, where it projects posteriorly in a very long and slender tooth. There is a similar but much smaller tooth on the three succeeding somites, though in two of the three specimens examined it is nearly or quite obsolete on the fourth somite. The epimera of the four anterior somites are broad and very deep, the height of the abdomen at these somites being as great as or greater than that of the carapax. The first epimeron is as deep as the second, and its anterior edge is slightly concave in outline and projects a little below; the second is about as broad as high, and approximately orbicular; the third and fourth project posteriorly in broadly rounded lobes; the fifth projects posteriorly in an angular lobe obtusely rounded at the tip. The sixth somite is nearly twice as long as the fifth, and about twice as long as high.

The telson is considerably longer than the sixth somite, very slender toward the tip, rounded and slightly sulcated above, and armed with four or five pairs of stout dorsal aculei on the distal half. The outer lamella of the uropod scarcely reaches the tip of the telson, is about four times as long as broad, tapers very slightly except near the tip, which is ovate and projects nearly the width of the lamella beyond the angle in which the thickened outer margin ends; the inner lamella is obtusely lanceolate, and considerably shorter and a little narrower than the outer.

The outer ramus of the appendage of the first somite of the abdomen is long and slender, and like that of the succeeding appendages, but the inner ramus is

developed into a broad oval lamella about a third as long as the outer ramus, with both margins setigerous and the inner thickened and bearing a slender stylet armed as usual with minute hooks. The inner ramus of the appendage of the second somite bears the two stylets usually characteristic of the male.

A small and imperfect female specimen appears not to differ from the males as above described except in the usual sexual characters. The inner ramus of the first abdominal appendage is a very small lamella nearly four times as long as broad and furnished with very long and slender setæ.

The surface of the carapax and abdomen is very nearly naked, but is roughened by minute granular projections.

The number and structure of the branchiæ seem to be essentially the same as in the typical species of *Pandalus*, but there is apparently no epipod at the base of the fourth leg, so that the branchial formula is as follows : —

Somites.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.	Total.
Epipods,	1	1	1	1	1	1	0	0	(6)
Podobranchiæ,	0	1	0	0	0	0	0	0	1
Arthrobranchiæ,	0	0	2	1	1	1	1	0	6
Pleurobranchiæ,	0	0	0	1	1	1	1	1	5
									12+(6)

The most perfect of the three specimens in the collection affords the following measurements : —

Station	330
Sex	♂
Length from tip of rostrum to tip of telson	80+ mm.
" of carapax excluding rostrum	16.0
" of rostrum	16+
" of antennal scale	11.7
Breadth of " "	3.0
Length of sixth somite of abdomen	10.0
Height " " "	5.0
Length of telson	13.0

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
305	41° 23′ 15″	65° 51′ 25″	810	1 ♂.
323	33° 19′ 0″	76° 12′ 30″	457	1 ♀.
330	31° 41′ 0″	74° 35′ 0″	1047	1 ♂.

Miersia gracilis, sp. nov.

Plate XI. Figs. 4 - 4[1].

Young male. — The carapax is slightly compressed, and including the rostrum only a little shorter than the abdomen ; the dorsum is rounded posteriorly, but carinated in front of the middle, and rises anteriorly into a high and sharp crest

which extends to the base of the rostrum ; and the anterior margin is armed as in *M. Agassizii*. The rostrum is considerably longer than the carapax proper, very slender, directed slightly downward for a short distance from the base, and is then nearly horizontal to the very slender and acute tip; is armed above for its whole length with fourteen teeth, of which the four or five posterior are nearer together than the others, and the two posterior very small and back of the orbit on the carapax proper ; and is armed below with nine teeth from in front of the eye to the tip.

The eyes are very much larger than in *M. Agassizii*, pyriform, and black. The antennulæ are very nearly as in *M. Agassizii*, but the thickened proximal part of the outer or major flagellum is relatively a little shorter. The antennal scale is about half as long as the rostrum, about three fourths as long as the carapax excluding the rostrum, and of nearly the same form as in *M. Agassizii*.

The labrum and metastome are nearly as in *M. Agassizii*. The mandibles differ from those of *M. Agassizii* in the molar areas being very small, nearly obsolete, and not distinctly separated from the ventral process, which is armed with teeth more uniform in size and not becoming rudimentary anteriorly. The terminal segment of the mandibular palpus is slightly shorter than in *M. Agassizii*, but in other respects the palpus does not differ. The distal lobe of the protognath of the first maxilla is very broad at the prehensile edge, and the lobe is much larger than the proximal lobe ; the endopod is more slender than in *M. Agassizii*, is armed with one in place of two spines on the fold near the distal extremity, and is without marginal setæ. The divisions of the distal lobe of the protognath of the second maxilla are much broader distally, presenting much longer prehensile edges, and the scaphognath is narrower than in *M. Agassizii*. The protopod of the first maxilliped is as in *M. Agassizii*, but the exopod and endopod (Pl. XII. fig. 10) differ conspicuously. The endopod is more slender and the distal segment is very much shorter, while the lamelliform exopod has the inner angle of the distal extremity prolonged and indistinctly segmented, thus approximating to the early stages, in which it is doubtless flagelliform. The second maxilliped is as in *M. Agassizii*, except the terminal portion of the endopod (Pl. XI. fig. 4^{d}) which differs in the same way as that of *Pandalus tenuipes* differs from that of *P. acanthonotus* (Pl. XIII. figs. 11, 12), but to a greater extent, the dactylus being narrow, longer than broad, and transversely articulated with the propodus.

The external maxillipeds and chelate legs are almost exactly as in *M. Agassizii*. The third and fourth pairs of legs are alike, and differ from those of *M. Agassizii* in having shorter carpi scarcely half as long as the meri, propodi about twice as long as the carpi, and dactyli only a very little shorter than the propodi, slender, slightly curved, and armed with a few minute spines. The posterior legs are scarcely three fourths as long as the fourth, but the segments have nearly the same relative proportions except the dactylus (Pl. XI. fig. 4^{e}), which is about a third as long as the propodus, obtuse at the tip, and armed along the lower edge and at the tip with serrate setæ, of which the terminal

ones are much the longer, while the proximal are like those upon the propodus, which is armed with serrate setæ somewhat as in *M. Agassizii*.

The abdomen is a little more slender than in *M. Agassizii*, and the third, fourth, and fifth somites are more conspicuously toothed, but none of the somites are distinctly carinated except the third, which is strongly carinate, or crested, and projects over the fourth somite in a very strong tooth, and the fourth and fifth, which are anteriorly rounded above, and have a short carina-like elevation at the base of the tooth. All the epimera are somewhat smaller than in *M. Agassizii*, but similar in form to those of that species except that the fifth has a distinct tooth in the postero-dorsal edge. The sixth somite is fully twice as long as the fifth, twice as long as high, and strongly compressed laterally.

The telson is a little longer than the sixth somite, about as long as the antennal scale, slender, and tapers to a long and slender tip armed either side with six to eight spines, besides five or six pairs of dorsal aculei above the tip. The lamellæ of the uropods are almost exactly as in *M. Agassizii*.

The inner ramus of the appendage of the first somite of the abdomen (Pl. XI. fig. 4[b]) is a little more than a third as long as the slender normal outer ramus, fully three times as long as broad, ciliated along the outer edge, the inner edge straight, and projecting slightly distally, where it is armed with the usual hooklike spines for holding together the appendages of the two sides of the animal. The inner ramus of the appendage of the second somite bears the usual two stylets (Pl. XI. fig. 4[c]), but the secondary stylet, specially characteristic of the male, is rudimentary, only about a fifth as long as the other, is terminated with a single long seta, and undoubtedly indicates that the specimen is immature.

The surface of the carapax and abdomen is naked, but thickly and conspicuously punctated.

The branchial formula is apparently the same as in *M. Agassizii*.

The single specimen is from Station 328, N. Lat. 34° 28′ 25″, W. Long. 75° 22′ 50″, 1632 fath., and gives the following measurements : —

Sex	♂
Length from tip of rostrum to tip of telson	44.0 mm.
" of carapax including rostrum	20.0
" of rostrum	12.0
" of antennal scale	6.0
Breadth of " "	1.6
Length of sixth somite of abdomen	5.5
Height of " " "	2.7
Length of telson	6.0

This species is perhaps not congeneric, or consubgeneric, with *M. Agassizii*, but it seems best to refer them both to the present genus until their relations to the typical Mediterranean species of *Miersia* can be better determined.

The form and dentition of the rostrum of *Miersia gracilis* appear to be much

like *Acanthephyra debilis* A. Milne-Edwards (Ann. Sci. Nat., 6me series, XI. No. 4, p. 13, 1881), and it is possible that the species may be identical, — or, on the other hand, that they may belong to very different genera. Milne-Edwards says: "Le genre *Acanthephyra* semble rattacher les *Penæus*, les *Regulus*, les *Oplophorus* et les *Ephyra*," but gives no characters which enable me to tell how the genus differs from *Miersia* (*Ephyra*), though the species of *Miersia* appear to be very little known, as I have already remarked, and Milne-Edwards may have had opportunities of examining typical specimens, to which, however, he does not allude. *Miersia Agassizii* is evidently very distinct from any of the species of *Acanthephyra* described by Milne-Edwards.

MENINGODORA,* gen. nov.

Integument throughout very thin and membranaceous. Body compressed laterally and the carapax dorsally carinate anteriorly, with a short triangular rostrum, a well-developed branchiostegial spine as in *Miersia*, and with an antennal and hepatic sulcus, above which there is a carina which is continued back along the dorsal limit of the branchial region, — a form of areolation strongly recalling the Penæidæ. Antennal scales broad and foliaceous, but all the other articular appendages essentially as in *Miersia*. The branchiæ (phyllobranchiæ) have the same structure and arrangement as in *Miersia*, except that there is apparently but one arthrobranchia at the base of the external maxilliped, making in all eleven branchiæ and six epipods each side.

Although differing very conspicuously in general appearance from the species of *Miersia* here described, this genus is very closely allied to them, as a comparison of the figures of the appendages will show, but it is sufficiently distinguished by the characters above given. Its relation to *Hymenodora* † is more obscure, though perhaps equally close. In *Hymenodora* the body is not compressed, and according to Buchholz's figure the epimera of the second somite of the abdomen do not overlap the epimera of the first segment, but are of the same form as the succeeding epimera, and this seems to be confirmed by the clause in Sars's generic diagnosis, "epimeris æqvaliter rotundatis." Moreover, the endopod of the first maxilliped, according to Sars, is not segmented ("parte terminali (propria) angusta, inarticulata"). On the other hand, the number of the branchiæ is apparently the same, though Sars's statement ("branchiæ utrinqve 6, antica et postica simplex, ceteræ bipartitæ; præterea adsunt branchiæ supplementariæ, indivisæ, laminaceæ, basi maxillipedum 1mi et 2di paris affixæ") does not make this perfectly clear.

* Μῆνιγξ, *a membrane*; δορά, *skin*.

† *Hymenodora glacialis* G. O. Sars, Archiv Mathem. Naturvid., Kristiania, II. p. 341, 1877 (*Pasiphaë glacialis* Buchholz, Zweite deutsche Nordpolfahrt, II. p. 279, Pl. I. fig. 2, 1874).

Meningodora mollis, sp. nov.

Plate XI. Figs. 8-9. Plate XII. Figs. 5-9.

Female. — The carapax including the rostrum is about two thirds as long as the abdomen to the tip of the telson, about half as high as long, and considerably compressed; the dorsal carina is high and very sharp in front, gradually diminishes posteriorly, scarcely reaches the posterior margin, and anteriorly extends to the tip of the acutely triangular rostrum, which is about half as long as the antennal scale and only about a seventh as long as the carapax. On the dorsal carina just back of the base of the rostrum there are five or six very indistinct rudimentary teeth scarcely perceptible to the naked eye and too minute to be indicated in the figure. The anterior margin projects in a triangular lobe above the base of the antenna, and is armed below with an acute and laterally prominent branchiostegial spine very much as in *Miersia Agassizii*. From just back of the eye a distinct gastro-antennal and gastro-hepatic carina extends backward and downward and divides, the upper branch continuing back in a gastro- and cardiaco-branchial carina, and the lower turning down in front of the branchial region and limiting a wide antennal and hepatic sulcus behind. The inferior and posterior edges are broadly and evenly curved.

The eyestalks (Pl. XI. fig. 8[a]) scarcely reach the tip of the rostrum, are nearly cylindrical, slightly swollen near the base and tapered distally, with a papilla-like tubercle just back of the cornea on the inner side and very small terminal black eyes no thicker than the adjacent stalk.

The first segment of the peduncle of the antennula is about as long as the eye and rather longer than the other two taken together, flattened and somewhat excavated above and with a rather broad lateral lobe terminating in a tooth nearly as far forward as the extremity of the body of the segment itself; the second and third segments are subcylindrical and approximately equal, but the third projects below in a process for the articulation of the lower flagellum far beyond the base of the upper flagellum. The proximal part of the upper flagellum is much stouter than the lower, somewhat compressed, not conspicuously swollen at the base, and hairy along the lower edge. The lower flagellum is very slender, cylindrical, and nearly naked. The antennal scale is rather more than twice as long as the eye, nearly half as broad as long, very thin, foliaceous, slightly narrowed distally, and obliquely truncated at the tip, which extends a little beyond the small tooth in which the slightly curved outer margin terminates. There are no acute teeth or spines on the second segment of the peduncle at the base of the scale.

The oral appendages are all very nearly as in *Miersia Agassizii*, the differences being no greater in fact than might be expected between species belonging to the same genus. The labrum is nearly the same, but the lobes of the metastome are much narrower. The mandibles (Pl. XII. figs. 5, 5[a]) are much the same, but the mesial edge of the ventral process is short and armed with

only five or six teeth, while the anterior edge is entirely unarmed ; the molar area is considerably larger, and is rounded above instead of angular ; the palpus is a very little larger and the second segment proportionally a little longer. The proximal lobe of the protognath of the first maxilla (Pl. XII. fig. 6) is more angular anteriorly and its mesial edge a little longer, and the endognath has but a single spine on the fold near the tip. The protognath and endognath of the second maxilla (Pl. XII. fig. 7) are almost exactly the same, but the scaphognath is larger, more prolonged and ovate in outline at the tip, and the posterior portion projects inward less prominently. The endopod of the first maxilliped (Pl. XII. fig. 8) is much stouter and the two distal segments much more nearly equal in length, and the exopod is more expanded anteriorly and more prolonged at the outer than at the inner edge. The endopod of the second maxilliped (Pl. XI. fig. 9) is a very little stouter proximally and has a rather shorter carpus, but differs very slightly ; the exopod is a very little longer ; and the epipod is narrower at base, more ovate in outline, and bears a branchia composed of only a few pairs of lamellæ.

The endopods of the external maxillipeds reach considerably beyond the tips of the antennal scales, and are composed of three segments each, as in *Miersia Agassizii*, but are considerably stouter than in that species ; the proximal segment is distally stouter than any part of the other segments and nearly as long as the other two together; the middle segment is scarcely more than a fourth as long as the proximal, and the distal is triquetral, tapers to an acute point, and is nearly naked but armed with a few minute spines near the tip. The exopod is multiarticulate, flagelliform, as in *Miersia Agassizii*, and about as long as the proximal segment of the endopod. The epipod is nearly as in *Miersia*.

All the thoracic legs are furnished with exopods like the external maxillipeds, and the first, second, and third pairs are furnished also with epipods as in the external maxillipeds. The legs of the first pair are not stouter than the external maxillipeds and fall considerably short of their tips : the merus is compressed and nearly as long as the proximal segment of the endopod of the external maxilliped ; the carpus is scarcely half as long as the merus, subcylindrical, and slightly enlarged distally ; the chela is about twice as long as the carpus, very slightly swollen proximally, and the digits nearly a third the whole length, strongly curved at the tips, and the propodal one considerably stouter at base than the dactylus. The legs of the second pair are very slender, and reach a little by the tips of the external maxillipeds : the ischium and merus are strongly compressed, and the latter is longer than in the first pair and reaches to the distal extremity of the proximal segment of the endopod of the external maxilliped; the carpus is slender, cylindrical, and about half as long as the merus ; the chela is slightly longer than the carpus, scarcely as long as in the first pair, cylindrical, scarcely as stout as the carpus, not at all swollen, and with very slender and slightly compressed digits about two sevenths the entire length. The third and fourth pairs of legs are nearly alike : the ischia and meri are compressed, and nearly as in the second pair, but a little longer ; the carpi are a little shorter and broader than in the second pair ; the propodi and

dactyli are wanting on both sides. The ischium, merus, and carpus in the posterior legs are nearly as in the third and fourth pairs, but the merus is a little shorter and narrower, while the terminal portion (Pl. XI. fig. 6) is very nearly as in *Miersia Agassizii:* the propodus is longer than the merus, nearly three times as long as the carpus, slender, nearly cylindrical, and is armed near the middle with several very long and slender setæ, toward the distal end with numerous short serrate setæ, and about the base of the dactylus with numerous long serrate, plumose and simple setæ ; the dactylus is very short and stout, scarcely as long as the diameter of the propodus, strongly curved at the tip and armed along the lower side with several spines.

The abdomen is considerably compressed, and has a sharp, but not very high, dorsal carina on the third, fourth, fifth, and sixth somites, and is prolonged posteriorly into a small tooth on the fourth and fifth somites. The outlines of the epimera are very nearly as in *Miersia Agassizii*, but the posterior margins of the third, fourth, and fifth are perhaps a little fuller and more broadly rounded. The sixth somite is scarcely once and a half as long as the fifth, and about twice as long as high.

The telson is nearly twice as long as the sixth somite, very slender distally, the dorsum is without aculei but with a broad sulcus within the broadest part of which there is a median longitudinal elevation, and the tip is armed with a pair of lateral and a pair of very slender median spines.

The outer lamella of the uropod reaches slightly by the tip of the telson, is about three times as long as broad, and with the tip rather broad and extending a little by the tooth in which the outer margin terminates, and within which there is a small spine. The inner lamella is a little shorter than the outer, about four times as long as broad, and lanceolate at tip.

The outer ramus of the appendage of the first somite is longer than the protopod and like that of the succeeding pairs, while the inner is a minute lamella about twice as long as broad. The inner rami of the four succeeding pairs of appendages are each furnished with the usual stylet for attaching together the two appendages of each pair.

There is but a single specimen in the collection, a female, wanting the left leg of the second pair and the terminal portions of both legs of the third and fourth pairs, from Station 328, N. Lat. 34° 28′ 25″, W. Long. 75° 22′ 50″, 1632 fathoms. This specimen gives the following measurements: —

Sex	♀
Length from tip of rostrum to tip of telson	75.0 mm.
" of carapax including rostrum	30.3
" of rostrum	4.5
" of antennal scale	9.5
Breadth " "	4.5
Length of sixth somite of abdomen	8.0
Height " " "	4.0
Length of telson	15.5

EUMIERSIA, gen. nov.

Resembles *Pandalus* in the external form of the carapax and abdomen, and agrees with it essentially in the structure of the oral appendages, and the two species known to me have the same number and arrangement of branchiæ and epipods as in the typical species of *Pandalus;* but the genus is more like *Miersia* in the structure of the thoracic legs, which, however, are greatly more elongated than in the species of that genus here described, and have only very small epipods at the bases of the fourth pair and none at all upon the fifth. The mandibles, though essentially as in *Pandalus*, are stouter and have larger molar processes, while the ventral processes are very thin, more expanded, and with broader serrate tips, thus approaching somewhat to the structure in *Miersia.* The mandibular palpi are much stouter than in the typical species of *Pandalus*, and have broad terminal segments.

Eumiersia ensifera, sp. nov.

Plate XIII. Figs. 1-9.

The carapax is as broad as high, with the cervical suture indicated by a distinct sulcus from the dorsum to the upper part of the hepatic region either side, where the sulcus terminates in a small but deep depression, and with a very short and inconspicuous gastro-antennal sulcus; the anterior margin is armed with a small antennal and a distinct pterygostomian spine, though the latter is wanting on one side in two of the specimens seen; back of the cervical suture the dorsum is very broad and evenly rounded, but there is usually a very small dentiform tubercle in the middle line on the posterior part of the cardiac region; the rostrum in the smaller specimens is often not more than half as long as the carapax proper, but in the larger specimens much longer and in one specimen nearly as long as the carapax, nearly straight and horizontal, or curved considerably upward as in the specimen figured, narrow, with a strong ridge either side, tapering to a more or less acute tip, and with the dorsal carina extending back upon the carapax nearly to the cervical suture and armed with twenty-five to thirty spines directed forward, movably articulated with the carapax, thickly crowded posteriorly but more and more remote anteriorly, and of which six to eight are crowded upon the carapax in about half the space between the orbit and the cervical suture; beneath, the rostrum is ciliated and in most of the specimens entirely unarmed, but in two or three cases there are one or two teeth near the tip.

The eyestalks are short and terminated by small hemispherical black eyes very nearly as in *Miersia Agassizii.* The peduncle of the antennula is about half as long as the antennal scale: the first segment is about as long as the two others taken together, excavated above for the reception of the eye, which, however, does not reach by a considerable distance the extremity of the segment, with a prominent lateral process terminating in an acute spine, and the body

of the segment itself produced in a spiniform process outside the articulation with the second segment; the second and third segments are subequal in length and nearly cylindrical. The flagella are imperfect in all the specimens seen, but both were very long and slender: the upper or major flagellum is slightly compressed near the base but not suddenly expanded, and was at least as long as the carapax and apparently very much longer; the inferior flagellum was a little smaller at the base than the superior, cylindrical, and apparently about as long as the superior. The antennal scale is thick and strong, seven or eight tenths as long as the carapax excluding the rostrum, about a fourth as broad as long, only slightly narrowed toward the tip, which is truncated and does not extend beyond the strong tooth in which the thickened outer margin terminates; the second segment is armed with a small spiniform tooth below the articulation of the scale; the third segment projects scarcely beyond the second; the fourth and fifth are very short, and the fifth does not project more than its diameter in front of the second. The flagellum is wanting in all the specimens seen.

The labrum is very large, the ventral surface flattened, broader than long, and approximately rectangular, the antero-lateral angles being expanded below so as to reach nearly as far forward as the middle portion, which projects in a tuberculiform lobe a little above the plane of the ventral surface. The lobes of the metastome are broad and rather fleshy, as in *Pandalus*. The molar process of the mandible (Pl XIII. figs. 2, 2ª) is stout, the mesial surface somewhat convex, and broken by several semicircular and concentric ridges, of which the one nearest the base of the ventral process is armed with a closely-set series of setæ. The ventral process is thin, distally broad and somewhat concave above, and armed with about eight rather slender teeth. The palpus is a little longer than the ventral process, the first and second segments subequal in length, and the third longer and much broader than the second, lamellar, and armed with numerous setæ. The proximal lobe of the protognath of the first maxilla (Fig. 3) is large, somewhat triangular, with the mesial edge two or three times as long as that of the narrow distal lobe; the endognath is much shorter than the distal lobe of the protognath and truncated at the extremity, which is armed with a stout seta either side and a third one just below the tip. The second maxilla (Fig. 4) is very nearly as in the typical species of *Pandalus:* the proximal lobe of the protognath is very much shorter than the distal, and its small anterior division is more conspicuous than in the typical species of *Pandalus*, while the two divisions of the distal lobe are nearly equal in size; the endognath is scarcely half as long as the distal lobe of the protognath; the anterior portion of the scaphognath is a little longer than the posterior, which, as in the typical species of *Pandalus*, is narrowed to an acute point, and the mesial edge furnished with exceedingly long setæ, many times longer than those upon the outer edge.

The distal lobe of the protopod of the first maxilliped (Fig. 5) is somewhat triangular in outline; the two proximal of the three segments of the endopod are subequal in length, while the distal segment is very short, but little longer

than broad; the lamellar portion of the exopod reaches slightly beyond the endopod, and the flagelliform is a little longer than the lamellar portion. The ischium and merus in the second maxilliped (Fig. 6) are subequal in length; the propodus is about as long as the ischium and merus taken together, and about half as broad as long; the dactylus is articulated obliquely along the distal end of the propodus, and is five or six times as broad as long; the flagelliform exopod is slender, nearly twice as long as the endopod, and multiarticulate for half its length; the epipod bears a well-developed branchia composed of two series of numerous lamellæ. The endopods of the external maxillipeds reach nearly to the tips of the antennal scales: the proximal segment is nearly as long as the two distal, vertically compressed, with a knifelike mesial edge; the middle segment is very slender, cylindrical, and nearly naked; the distal segment is about two thirds as long as the middle, somewhat triquetral, very slightly expanded near the middle, tapered to a point distally, and armed with numerous short setæ. The exopod is very slender and about three fourths as long as the proximal segment of the endopod. The epipod is rudimentary, scarcely longer than the breadth of the protopod, in a transverse sulcus on the outer side of which it lies.

The first four pairs of thoracic legs have exopods and epipods like the external maxillipeds, but the exopods diminish in size very rapidly posteriorly, and are minute upon the fourth pair. The legs of the first pair (Fig. 7) are about as long as the carapax including the rostrum and reach to or a little by the tips of the antennal scales: the ischium is slightly longer than the merus, and both are very slender and armed with a few small spines; the carpus is very much more slender than the merus, and about twice or considerably more than twice as long, slightly enlarged at the distal extremity, and entirely naked and unarmed; the chela in the larger specimens seen is a fourth or fifth as long as the carpus, considerably stouter, slightly flattened, and the digits about a third of the entire length, slightly curved, and rather sparsely clothed with slender setæ. The second (Fig. 8) are similar to the first, but very much longer and more slender: the chela is just about as long as in the first pair, but not quite as stout, while the ischium, merus, and carpus are very much longer than in the first pair. The third, fourth, and fifth pairs of legs are more or less broken in all the specimens seen, but are very long and slender, and are all apparently longer than the second pair. The only one of these legs which is complete belongs to a female 108 mm. long, and is apparently one of the posterior pair, but is, unfortunately, detached. This leg (Fig. 9) is nearly twice as long as the first pair in the same specimen, and much more slender than the second even: the ischium and merus make a little more than half the entire length; the carpus is much longer than the merus, exceedingly slender, somewhat enlarged at the distal extremity, and entirely naked; the propodus is fully as stout as the adjacent part of the carpus, scarcely more than a tenth as long, and armed with a few short setæ on the dorsal side, a fascicle of longer setæ beneath, and a circle of very long ones about the base of the dactylus, which is slightly longer than the carpus, slender, and very slightly curved.

The first and second somites of the abdomen are broadly rounded above and not at all compressed, but the succeeding somites are considerably compressed, particularly near the dorsum, which is not really carinated on any of the somites, however, though the third somite is prolonged in a very prominent tooth over the fourth. The first epimeron is broad and evenly rounded below, the second much longer than high and elliptical, the third and fourth with the posterior edges rounded, but the fifth produced posteriorly in an acute point. The sixth somite is about twice as long as the fifth, less than half as high as long, and very strongly compressed.

The telson is about as long as the sixth somite, narrow distally, rounded above, and armed with five to ten pairs of dorsal aculei and two pairs of long spines at the tip. The outer lamella of the uropod reaches to about the tip of the telson, is nearly four times as long as broad, with the rounded tip extending much beyond the tooth in which the stout outer margin terminates and just within which there is a spine as in most species of *Pandalus*. The inner lamella is considerably shorter and much narrower than the outer, and lanceolate in outline.

In the female, the inner ramus of the appendage of the first somite of the abdomen is lamellar, about two thirds as long as the outer, four times as long as broad, and tapered to an acute point. In the male, this ramus is lamelliform, but shorter and very much broader, being ovate and about twice as long as broad. In the male the sexual appendage at the side of the stylet of the inner ramus of the appendage of the second somite is as long as the stylet, and expanded distally into a broad lamelliform and obtusely rounded tip.

The surface of the carapax and abdomen is naked, but thickly punctate.

All the specimens are imperfect and many of them fragmentary, and the accompanying measurements are consequently very incomplete.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
305	41° 33′ 15″	65° 51′ 25″	810	2 ♀ young.
308	41° 24′ 45″	65° 35′ 30″	1242	3 ♀
330	31° 41′ 0″	74° 35′ 0″	1047	2 ♂ young.
339	38° 16′ 45″	73° 10′ 30″	1186	2 ♂ small.
340	39° 25′ 30″	70° 58′ 40″	1394	2 ♀
341	39° 38′ 20″	70° 56′ 0″	1241	2 ♂

The following measurements are in millimeters : —

Station	330	339	308	340	340
Sex	♂	♂	♀	♀	♀
Length from tip of rostrum to tip of telson	44.0		108.0	122.0	125.0
" of carapax including rostrum	15.1	25.5	42.0	48.0	51.0
Breadth of carapax	4.8	7.5	11.0	13.0	13.5
Length of rostrum	4.8	9.5	17.0	21.3	23.3
" of antennal scale	6.8	11.3	16.2	19.0	19.5
Breadth " "	1.5	3.0	4.4	4.7	5.0

Station	330	339	308	340	340
Sex	♂	♂	♀	♀	♀
Length of first leg	16.0	26.0	40.0		
" ischium	3.7	6.0	9.0		
" merus	3.3	5.8	7.8		
" carpus	6.5	9.5	17.0		
" chela	2.5	3.1	4.1		
" dactylus	0.9	1.1	1.4		
" second leg	25.0				
" ischium	6.0				
" merus	6.5				
" carpus	9.0				
" chela	2.5				
" dactylus	0.8				
" fifth (?) leg			77.0		
" ischium			18.0		
" merus			23.0		
" carpus			28.0		
" propodus			3.0		
" dactylus			3.3		
" sixth somite of abdomen	8.0		16.0	17.0	17.2
Height of " " "	2.7		7.0	7.3	7.5
Length of telson	6.7		15.0	18.0	17.8

PENÆIDÆ.

? BENTHESICYMUS Bate.

A single mutilated male specimen is referred very doubtfully to this genus, recently and only very imperfectly characterized by Bate. This specimen wants the larger part of the external maxillipeds, of the flagella of the antennæ and antennulæ, and of the three last pairs of thoracic legs, but the branchial formula is the same as given by Bate for his genus, and as far as the diagnosis goes the specimen agrees with it. There is nothing in the branchial formulæ given by Bate in regard to the seventh somite (the first maxillipedal), but in the specimen before me there is an epipod and a single arthrobranchia at the base of the first maxilliped. The eighth somite bears two arthrobranchiæ, a podobranchia, and an epipod; the ninth to the twelfth inclusive bear each a pleurobranchia, two arthrobranchiæ, a podobranchia, and an epipod; the thirteenth bears a pleurobranchia, two arthrobranchiæ, and an epipod; and the fourteenth bears a pleurobranchia only: making in all twenty-four branchiæ and seven epipods, and of the true branchiæ six are pleuro-, thirteen arthro-, and eight podobranchiæ. The species here described has no exopods at the bases of the thoracic legs, and the maxillæ and first and second maxillipeds are much less

like *Penæus* than like *Stenopus hispidus* as figured by Boas; and the species is not so closely allied to *Penæus* as might be inferred from the description of *Benthesicymus* and its place in Bate's arrangement.

Benthesicymus Bartletti, sp. nov.

Plate XIV. Figs. 1-7.

Male. — The carapax is only slightly compressed laterally, and its surface, as well as that of the abdomen, is naked and polished, but is very conspicuously and peculiarly areolated. There is only one spine each side, a prominent and acute branchiostegial, and from this a sharp carina extends back parallel with the inferior margin to near the middle of the carapax, where it is interrupted by a well-marked sulcus which, beginning as the antennal, turns slightly downward, runs back above and contiguous to the carina just described, and then turns down and nearly reaches the inferior margin; back of this carina a somewhat similar but much less conspicuous cardiaco-branchial carina accompanied by a slight sulcus extends to near the posterior margin of the carapax; there is a slight gastro-frontal sulcus at the base of the rostrum; a very deep and conspicuous transverse gastric sulcus, which slightly notches the dorsum at about the middle of the carapax, extends in an even curve downward and forward, as the gastro-hepatic, and joins the hepatic sulcus a little way back of the branchiostegial spine; and back of this sulcus there is a distinct but much less conspicuous cervical, extending from very near the middle line, at about a third of the way from the transverse gastric sulcus to the posterior margin, downward to the cardiaco-branchial suture. In front of the transverse gastric sulcus there is a sharp dorsal carina which rises into a lamellar crest and terminates in a short and laterally compressed rostrum armed above with two sharp teeth of which the posterior is slightly back of the orbit and the anterior apparently about half-way between it and the tip, which is slightly broken but appears to have terminated in an acute point about two thirds of the way from the base to the tip of the eyestalk. Both edges of the rostrum are ciliated. Back of the gastric sulcus the dorsum is broad and evenly rounded transversely.

The eyestalks (Pl. XIV. figs. 1, 1ª) are less than half as long as the antennal scales, slender, strongly compressed vertically, with a small obtuse dentiform prominence at the middle of the inner side, and just in front of and outside of this a small spot of black pigment showing faintly on the upper but conspicuously on the lower side. The eyes themselves are scarcely wider than the stalks, but are less compressed vertically, though still much broader than high, distinctly faceted, and dark brown in the alcoholic specimen.

The peduncles of the antennulæ (Figs. 1, 1ª) are more than half as long as the antennal scales, and essentially as in the species of *Penæus*. The first segment is considerably longer than the two others taken together, is expanded laterally and deeply excavated above to fit the eye, and the outer margin is armed with an acute tooth opposite the extremity of the eye and another at the

distal end ; the second and third segments are subequal in length, and the terminal is considerably prolonged beneath at the origin of the lower flagellum ; the inner and distal margins of the first segment, and nearly the whole exposed surface of the second and third, are thickly clothed with hair. The proximal part of the lower flagellum is about as stout as the flagellum of the antenna, nearly cylindrical, and naked ; while the upper is considerably stouter and ciliated along the inner side.

The segments of the peduncles of the antennæ are all smooth, nearly naked, and externally unarmed, but the second segment bears, on the upper and inner edge, a slender spine curved forward and outward above the base of the scale, and there is a papilla-like prominence just above the opening of the green gland at the distal extremity of the first segment ; the consolidated fourth and fifth segment is about as long as the three others taken together, is subcylindrical, and the distal segment prolonged in a thin triangular process inside the origin of the flagellum ; the scale (Fig. 1[a]) is about two thirds as long as the carapax, and about three times as long as broad, the greatest breadth being near the base, but the margins only slightly converging distally except near the tip, which is obliquely rounded and extends considerably beyond the acute spine in which the very slightly arcuate outer margin terminates. The proximal part of the flagellum is very slender, naked, and slightly compressed vertically.

The labrum projects far below the epistome and is broadly caudate as seen in front, but this form is perhaps a result of contraction due to preservation in alcohol. The lobes of the metastome are narrow at the base, but expand into very broad and obtuse tips.

The mandibles (Fig. 2) are almost exactly alike, and nearly as in *Penæus*. They are somewhat contracted at the crowns, which are small, with the opposing surfaces somewhat semicircular in outline and each divided longitudinally by a narrow and shallow depression into two portions, of which the ventral is obtusely triangular and obscurely bidentate, while the dorsal portion is long and narrow anteriorly, but expanded at the posterior angle into a small and somewhat oval molar area with a raised and obscurely dentate margin. The mandibular palpus is composed of two lamellar segments, of which the proximal is considerably the longer and broader, while the distal is narrowly ovate with the tip rounded ; both segments are margined with soft hairs and plumose setæ.

The proximal lobe of the protognath of the first maxilla (Fig. 3) is small and ovate, the distal lobe obliquely truncated and armed as in the allied genera. The endognath is narrow, curved, unsegmented, and shorter than the distal lobe of the protognath.

The four lobes of the protognath of the second maxilla (Fig. 4) increase successively in size distally, the distal being twice as wide as the next. The endognath is much shorter than the distal lobe of the protognath, and tapers regularly to the tip. The anterior part of the scaphognath is much longer than the posterior and projects beyond the protognath, while the posterior part is short, broadly expanded, and strongly incurved at the extremity.

The protopod of the first maxilliped (Fig 5) projects anteriorly in a straight

lobe twice and a half as long as broad and rounded at the tip. The endopod is composed of three very distinct segments: a narrow basal one reaching a little by the protopod and with a slight expansion of the inner edge armed with slender spines, while the rest of the inner margin and the distal part of the outer are clothed with hairs; a second segment about half as long as the first, but expanded in the middle so as to be somewhat elliptical and nearly half as broad as long, with very long plumose setæ on the outer edge and smaller and more numerous ones on the inner; and a small terminal segment about a third as long as the second, half as broad as long, and edged with small setæ or hairs. The exopod is longer even than the endopod, the proximal two-thirds or three-fourths of its length wider than the first segment of the endopod, but the distal portion rather suddenly narrowed, multiarticulate, and flagelliform. The lamelliform branchial epipod is as large as the endopod and the anterior portion a little smaller than the posterior.

The endopod of the second maxilliped (Fig. 6) is approximately uniform in breadth throughout, except the dactylus: the ischium is broader than long; the merus is about as long as the three distal segments taken together, and about three and a half times as long as broad; the carpus and propodus are subequal in length and each a little longer than wide; the dactylus is a little shorter than the propodus, only half as wide as long, and narrowed to a somewhat triangular tip, which is armed with one or more curved spines; the edges of all the segments are more or less hairy or setigerous. The exopod is slender, regularly tapered, considerably longer than the endopod, and its distal half multiarticulate, flagelliform, and furnished with long plumose setæ, while the proximal part is unsegmented and furnished with short hairs or setæ. The epipod is short, nearly orbicular, and bears a short and dense dendrobranchia.

The endopod of the external maxillipeds is unfortunately wanting. The exopod is like that of the second except that it is a little smaller; the epipod is about as long as in the second, but narrow, ovate, and bears a dendrobranchia nearly as long as itself.

The first thoracic legs are slender and reach scarcely by the bases of the antennal scales: the merus is slightly longer than the ischium, and both these segments are strongly compressed vertically and ciliated along the inner edges; the carpus is slightly compressed, about as wide as the merus, and ciliated like it; the chela is scarcely as long as the carpus, and no stouter, and the digits are about as long as the basal portion, slender, very slightly curved at the tips, and the prehensile edges ciliated.

The second legs are much like the first, but a little more slender and considerably longer, reaching to the tips of the peduncles of the antennæ; the merus and carpus are subequal in length, and the chela is considerably shorter than the carpus.

The most of the endopods of the third, fourth, and fifth pairs of legs are wanting except a detached portion of, apparently, one of the fourth pair. This fragment is longer than the carapax and consists of a slender ischium and

merus, the latter twice as long as the former, a still more slender carpus nearly as long as the merus, and a portion of an exceedingly slender and filiform propodus.

The abdomen (Pl. XIV. fig. 1) to the tip of the telson is nearly twice as long as the carapax, anteriorly about as broad as high, but much compressed posteriorly, so that the sixth somite is fully twice as high as broad. The dorsum is evenly rounded on the first four somites, but there is a narrow and sharp carina on the fifth and sixth, which rises abruptly into a crest on the anterior part of the fifth. The posterior prolongations of the first and second epimera are broadly rounded ; those of the third and fourth less broad and more angular, but still obtuse and rounded at the posterior angle ; while the fifth is acutely angular, but with the tip itself obtuse. The sixth somite is twice as long as the fifth, and more than half as high as long. The telson wants the tip, but is apparently shorter than the sixth somite ; it is narrowly triangular, thickened and transversely very strongly convex above at base, but not carinated, and posteriorly flattened above.

The lamellæ of the uropods are thin and lanceolate in outline. The inner is only a little shorter than the sixth somite, less than a third as broad as long, and stiffened in the middle by two slender riblike thickenings, separated, on the dorsal surface, by a narrow sulcus. The outer is fully once and a half as long as the inner, scarcely a fourth as broad as long, and the narrow tip is prolonged far beyond the sharp spine in which the thickened outer margin terminates, and from this spine a slender riblike thickening, with a narrow sulcus along its inner edge on the dorsal surface, runs nearly parallel with the outer edge to the base of the lamella.

The abdominal appendages of the first pair are as large as those of the second, about as long as the uropods, and the distal multiarticulate portion is nearly twice as long as the protopod, slender and subcylindrical. The peculiar male appendage (petasma of Bate) is a thin, squarish plate (Pl. XIV. fig. 7) attached by a constricted base, below which there is a small oblong process (*a*) standing out at nearly right angles to the plane of the rest of the plate. The plate itself, which is apparently carried in a nearly horizontal position in front of the protopod to which it is attached, is obliquely divided vertically or longitudinally by imperfect articulations into three parts, of which the middle one is much the largest and projects at the inner inferior angle in a large ovately pointed process, while the inner or distal of the three parts is narrow and has the lower or posterior part of its free edge armed with minute hooked spines for the attachment of the appendages of the opposite sides of the animal. The outer rami of the second to the fifth pairs of abdominal appendages are similar to the single rami of the first pair, but are all considerably compressed distally. The inner ramus in the second pair is very much more slender and considerably shorter than the outer, and is furnished on the anterior side at base with two small and obtusely terminated, hard, lamelliform processes. The inner rami of the third, fourth, and fifth pairs of appendages are as in the first pair except that they are without the lamelliform process at base.

Length of carapax including rostrum	24.8+ mm.
" rostrum	3.5+
" antennal scale	17.1
Breadth of " "	5.2
Length of abdomen	53.0
" sixth somite	12.4
Height of "	7.5
Length of telson	10+
" inner lamella of uropod	11.0
Breadth of " " "	3.2
Length of outer " "	17.0
Breadth of " " "	4.0

Station 343, N. Lat. 39° 45′ 40″, W. Long. 70° 55′, 732 fathoms; one male.

AMALOPENÆUS, gen. nov.

Like the last species in general appearance, but readily distinguished from it by the second maxillipeds, in which the meri expand into broad opercular plates, and in having no podobranchiæ on any of the thoracic legs. The integument of the whole animal is membranaceous, and very soft and thin. The carapax, eyes, antennulæ, antennæ, mandibles, and maxillæ are nearly as in the species last described. The endopod of the first maxilliped is divided into three segments as in that species, but the terminal segment is larger than the penultimate, and the exopod is broad and lamelliform throughout. The merus of the second maxilliped is expanded in a thin lamelliform plate along the inside and beyond the articulation of the carpus, so that when the three distal segments are flexed they are concealed beneath it. In the external maxillipeds the ischium is longer than the merus, and both these segments are very much broader than the slender carpus and propodus, or than the short flattened and pointed dactylus. The first three pairs of thoracic legs are approximately equal and their chelæ are slender and subequal in size, but in the first pair the ischium and merus are compressed and considerably expanded. The fourth and fifth pairs of legs are about as long as the third, and very slender. There are no exopods at the bases of any of the thoracic legs. The branchiæ are arranged as in the last species except that there are no podobranchiæ at the bases of any of the thoracic legs, so that there are only twenty branchiæ and seven epipods on each side, as indicated in the following table.

Somites.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.	Total.
Epipods,	1	1	1	1	1	1	1	0	(7)
Podobranchiæ,	0	1	0	0	0	0	0	0	1
Arthrobranchiæ,	1	2	2	2	2	2	2	0	13
Pleurobranchiæ,	0	0	1	1	1	1	1	1	6
									20+(7)

Amalopenæus elegans, sp. nov.

Plate XIV. Figs. 8-14. Plate XV. Figs. 1-5.

The carapax is not at all compressed laterally, but about as broad as high, exceedingly thin and membranaceous, and its surface naked and polished. The branchiostegial spine is very minute and the carina which extends back from it is less conspicuous than the sharp gastro-antennal and gastro-hepatic carina which is continuous posteriorly with a distinct cardiaco-branchial one; between the gastro-antennal and the branchiostegial carinæ there is a wide antennal and hepatic sulcus, which posteriorly turns down in front of the branchial region; there is a slight gastro-frontal and a very conspicuous transverse gastric and gastro-hepatic sulcus, as in the last species, while the cervical itself is equally deep and conspicuous, notches the dorsum like the gastric and only a very little way back of it, is directed downward and backward and then in a regular curve forward round the hepatic region to join the hepatic sulcus. A sharp dorsal carina extends the whole length of the carapax, but is most conspicuous in front of the gastric sulcus, rises in front into a sharp lamellar crest armed with a single sharp tooth over the posterior margin of the orbit, and projects forward in a short but acute and laterally compressed rostrum, which scarcely reaches the middle of the eyestalks.

The eyes and eyestalks are very nearly as in the last species, but the dentiform prominence is very much more prominent and conspicuous; the color of the eye and position of the pigment spot are the same, though the latter is more conspicuous above than below.

The ultimate segment of the peduncle of the antennula is much longer than the penultimate, and these two taken together are nearly as long as the first segment, but in other respects the peduncle is as in the last species. In the male the flagella are proximally subequal in diameter, but the superior is expanded somewhat along the inner side for a short distance from the base.

The antennal scale (Pl. XIV. fig. 12) is much less than half as long as the carapax, nearly three times as long as the greatest breadth, which is near the base, from where the margins arcuately converge to a narrow but obtusely rounded tip, which is scarcely in advance of the small terminal spine of the outer margin. The rest of the antennal peduncle is nearly as in the last species, and is armed with a curved spine above the base of the scale in the same way, but the terminal segment is shorter to correspond with the shorter scale. The flagellum is nearly naked, very slender, and at least much longer than the rest of the animal.

The labrum, metastome, and crowns of the mandibles are nearly as in the last species, but the labrum is full and rounded below. The mandibular palpi (Pl. XIV. fig. 9) are very large, and reach nearly to the middle of the antennal scales: the proximal segment is more than half as broad as long, nearly twice as long as the distal segment, with the distal part of the mesial edge straight and the outer edge curved and directed inward distally so as to narrow the

segment very much at the articulation of the terminal segment, which is about twice and a half as long as broad, and ovate with the tip rounded.

The first maxilla is as in the last species except that the endognath (Pl. XIV. fig. 10) is expanded somewhat a little way from the base.

The proximal of the four lobes of the protognath of the second maxilla (Pl. XIV. fig. 11) is larger than the next, while the three others increase successively in size distally, though the distal is not more than a third broader than the one next it. The endognath is nearly as long as the distal lobe of the protognath, broadly expanded near the middle, where it is more than a third as broad as long and has a rounded prominence edged with slender setæ on the inner margin, but suddenly contracted to a very slender tip armed distally with four long setæ on the inner edge and with two or three stouter and curved setæ on the outer edge just below these. The scaphognath is nearly as in the last species except that the posterior part is a little narrower and not so strongly incurved.

The protopod and the branchial epipod of the first maxilliped (Pl. XV. fig. 3) are nearly as in the last species, but the endopod and exopod are very different. The proximal segment of the endopod does not reach the tip of the protopod, though it is between three and four times as long as broad, the inner edge is armed distally with three or four slender spines and the rest of the way with long setæ or hairs ; the second segment is a little narrower than the first, between a third and a half as long, about twice as long as broad, and margined with hairs ; the terminal segment is considerably wider than the second segment, and about once and a half as long, approximately elliptical, and margined all round with long setæ or hairs. The exopod is a little longer than the endopod, unsegmented, lamellar, very thin and of nearly uniform breadth throughout, rounded at the tip, and with both edges setigerous, the setæ upon the outer edge being long and plumose.

The ischium of the second maxilliped (Pl. XV. fig. 4) is very short ; the merus is considerably longer than the carpus and propodus combined, half as broad as long, and projects distally in a thin and broadly rounded lobe beyond the articulation of the carpus ; the carpus is as long as the breadth of the merus, less than half as broad as long, and somewhat narrowed proximally ; the propodus is a little shorter than the carpus, but as broad, and is slightly produced at the inner distal angle ; the dactylus is about two thirds as long as the propodus, nearly half as broad as long, obtusely pointed, and armed with a strong curved spine at the tip. The exopod is slender, reaches about to the extremity of the carpus, and is distinctly multiarticulate from near the base to the tip. The epipod is small, ovate, and bears a relatively large dendrobranchia.

The external maxillipeds (Pl. XV. fig. 5) reach nearly to the tips of the antennal scales and are longer than either the first or second pair of legs : the ischium is about a third of the entire length of the endopod, fully a third as broad as long, and very slightly narrowed proximally ; the merus is as broad and about two thirds as long as the ischium, and narrowed distally to the breadth of the

carpus ; the carpus is slightly shorter than the merus, and only about a third as wide ; the propodus is very nearly as long as the carpus, but a little narrower; the dactylus itself is a little broader than the propodus, but less than half as long, broadest at the middle and with the tip triangular and armed with a slender spine not much shorter than the segment itself ; both edges of the dactylus, the extremity and inner edge of the propodus, and the inner edge of the carpus, are armed with exceedingly long and slender setiform spines, and the inner sides of the proximal segments are, as usual, armed with setæ. The exopod is slender, reaches a little beyond the ischium, and is distinctly multiarticulate to near the base. The epipod is narrow, and not longer than the breadth of the ischium.

The first and second pairs of legs (Pl. XV. figs. 1, 2) are very nearly equal in length, the first pair reaching about to the extremities of the peduncles of the antennæ, and the second pair scarcely falling short of the same point. In both pairs the corresponding segments are of very nearly equal lengths, except the carpi which are a very little longer in the second pair, but the ischia, meri, and carpi are narrower in the second than in the first : the ischium is about two thirds as long as the merus, half as broad as long in the first pair, and scarcely more than a third as broad as long in the second ; the merus is nearly a third of the entire length of the endopod, slightly narrowed distally, and in the first pair more than a third as broad as long, but in the second pair scarcely more than a fifth as broad as long ; the carpus in the first pair is about two thirds as long and half as wide as the merus, while in the second pair it is absolutely a little narrower than in the first ; the chelæ are very nearly alike in both pairs, about as long and broad as the carpus in the second pair, with the fingers slender, curved at the tips, and scarcely more than two thirds as long as the basal portion ; the edges of the chelæ are furnished with fascicles of short setæ, the tips of the fingers densely clothed with much longer setæ and hairs, the inner edges of the other segments thickly clothed with plumose hairs and long setæ, and the outer edges sparsely clothed with short hairs, except on the carpus in the second pair where the outer edge is thickly hairy. The legs of the third pair are considerably longer and much more slender than those of the second, beyond which they reach by the length of their chelæ ; the ischium is about as long as in the second pair, but narrower ; the merus is twice as long as the carpus, very slender, and of nearly equal diameter throughout ; the carpus is a little shorter and scarcely stouter than the merus, and very slightly thickened distally ; the chela is very near the same size as in the first and second pairs, but the fingers are apparently a little longer in proportion.

The third and fourth pairs of legs are nearly alike, a little longer than the third pair and very slender, the fifth being a little more slender than the fourth, and both sparsely armed with long setiform spines, except upon the dactyli, which are nearly naked, long, very slightly curved, and acute.

The abdomen to the tip of the telson is about twice as long as the carapax, anteriorly about as broad as the carapax and with the dorsum broadly rounded, but much compressed posteriorly, so that the sixth somite is twice as high as

broad. None of the anterior somites are dorsally carinated or toothed, but the sixth, which is nearly twice as long as the fifth and half as high as long, has a thin dorsal carina nearly the whole length. The epimera of all somites are rather small, and the posterior angle is more or less rounded in all.

The telson is about two thirds as long as the sixth somite, narrowly triangular, thickened at base, with a longitudinal sulcus the whole length above and with a shorter one either side near the base, and with the tip truncated, narrow, and armed with a spine either side and a series of long plumose hairs between.

The inner lamella of the uropod is a little longer than the sixth somite, lanceolate, and about six times as long as broad. The outer lamella is about a fifth longer than the inner, scarcely wider proportionally, and with the ovate tip prolonged far beyond the sharp spine in which the outer margin terminates.

In both sexes the protopods of the appendages of the first to the fifth somite are stout and all nearly alike, the outer rami are all very long and slender, and the inner rami of the four posterior pairs are shorter and more slender than the outer. The peculiar sexual appendage of the first pair of appendages in the male is carried as in the last species, and, as in that species, consists of a thin, squarish plate (Pl. XIV. figs. 13, 14) divided by imperfect articulations into three parts and attached by a constricted base, below which there is a small, broad, oval process (*a*) ; but the middle of the three parts is as large as the two others combined, inferiorly projects beyond the other parts, and at either side there is an obtuse tooth, above the outer of which there is an obtuse lobe in the margin and then a deep and narrow notch separating the middle from the inner or distal part, while above the notch on the anterior side there is an oblong process (*b*) which may be turned either in over the distal part of the plate or out over the middle part ; the distal part is thin, membranous, curls easily over upon the middle part, and is armed along the free edge with minute hooked spines as in the last species. There are two small, lamelliform plates at the base of the inner ramus in the second pair of appendages of the male, as in the last species.

All the specimens are more or less imperfect, and most of them in very bad condition on account of the softness of the integument and the exceeding fragility of the appendages, so that it is nearly impossible to present a general figure of the whole animal or give accurate measurements. Three specimens, however, give the following approximate measurements in millimeters : —

Station	330	328	893
Sex	♂	♀	♀
Length of carapax including rostrum	9.7	13.5	12.5
" antennal scale		6.4	6.8
Breadth of " "		2.5	2.7
Length of abdomen	20.0	27.0	27.0
" sixth somite of abdomen	5.0	6.2	6.7
Height of " " "	2.5	3.5	3.2
Length of telson			5.0

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
323	33° 19′ 0″	76° 12′ 30″	457	2 ♀, fragmentary.
324	33° 27′ 20″	75° 53′ 30″	1386	1 ♂
325	33° 35′ 20″	76° 0′ 0″	647	1 ♀, fragmentary.
328	34° 28′ 25″	75° 22′ 50″	1632	2 ♀, 1 fragmentary.
330	31° 41′ 0″	74° 35′ 0″	1047	2 ♂
343	39° 45′ 40″	70° 55′ 0″	732	Fragments only.

From Station 325, there is the crushed and fragmentary cephalothoracic portion of another specimen, apparently of this species, but having two teeth on the crest of the rostrum, the second tooth being about half-way between the one above the posterior margin of the orbit and the tip of the rostrum.

This species has also been taken by the U. S. Fish Commission at the following stations off Block Island, in 1880 and 1881 : —

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
893	39° 52′ 20″	70° 58′ 0″	372	1 ♀
935	39° 45′ 0″	69° 44′ 45″	770	1 ♂
952	39° 55′ 0″	70° 28′ 0″	388	1 ♂

Among these were the only specimens which had either of the fourth and fifth pairs of legs, the telson, or the uropodal lamellæ perfect.

The specimens in alcohol retain for a considerable time bright purple markings about the oral appendages, and give out a peculiar, bright red, oil-like fluid, after the manner of the species of *Sergestes* and some of the deep-water Schizopoda.

Hymenopenæus debilis, gen. et sp. nov.

Plate XV. Figs. 6-11. Plate XVI. Figs. 1-3.

The whole integument is membranaceous and exceedingly thin and soft. The carapax is smooth, naked, slightly compressed laterally, and dorsally carinated the whole length but not conspicuously on the posterior part ; there are four large and acute lateral spines either side, — an antennal, an hepatic, one a little way back of the antennal, and another (branchiostegial ?) below and in front of the hepatic and near the lower edge of the carapax ; the gastro-hepatic sulcus is conspicuous and deep, and continues upward to the dorsal line considerably back of the middle of the carapax and terminates below in front of the hepatic spine in a depression from which a narrow sulcus extends backward and divides, sending a short branch downward in front of the branchial region and a long one back to become the cardiaco-branchial. The rostrum is nearly straight, a little less than half as long as the rest of the carapax along the dorsum, compressed but not high, terminates in an acute point, is armed above with six or seven teeth besides three more widely separated and nearly equidistant ones upon the anterior half of the carapax proper, and near the tip below with a closely set series of hairs.

The eyes are large, reniform, and black, as in the typical species of *Penæus.*

The peduncle of the antennula is much longer than the rostrum: the first segment is more than half the entire length, excavated above for the reception of the eye, but the lamelliform appendage is small, narrow, and concealed between the eyestalks; the second segment is about half as long as the first, and somewhat triquetral; the body of the ultimate segment is not quite half as long as the second, but is prolonged in a narrow process beneath the bases of the flagella; the upper flagellum is slender, cylindrical and longer than the carapax and rostrum; the proximal portion of the lower flagellum is slender and cylindrical, like the upper, but the terminal portion is wanting in all the specimens seen.

The antennal scale is about half as long as the carapax including the rostrum, nearly four times as long as broad, and contracted distally to a rather narrow but evenly rounded tip, which projects scarcely beyond the terminal spine of the outer margin. The second segment of the peduncle of the antenna is armed with a slender spine just outside the articulation of the scale, and the consolidated fourth and fifth segments reach nearly to the middle of the scale and are subcylindrical. The flagellum is slender, cylindrical, and three or more times as long as the rest of the animal.

The labrum, metastome, and crowns of the mandibles are nearly as in *Penæus.* The mandibular palpi (Pl. XVI. fig. 1) are very much as in the *Amalopenæus* just described, and reach to about the middle of the antennal scales: the proximal segment is about half as broad as long and once and two thirds as long as the distal segment, which is three times as long as broad, and ovate with the tip obtuse.

The proximal lobe of the first maxilla (Pl. XVI. fig. 2) is large, broadly rounded at the extremity, and armed with very long setiform spines and setæ; the distal lobe is broad and truncated at the extremity, and armed with slender spines and setæ rather shorter than on the proximal lobe; the endognath is shorter than the distal lobe of the protognath, has a slight expansion margined with hairs on the outer edge near the base, and tapers to an obtuse tip (Fig. 2^a) armed on the inner edge with three very long and distally plumose setæ, and on the anterior surface with very delicate hairs.

The second maxilla (Pl. XVI. fig. 3) is very much as in many species of *Penæus.* The three proximal lobes of the protognath are subequal and narrow, and the distal lobe about twice as wide as they, but still rather narrow and ovate. The endognath is much shorter than the distal lobe of the protognath, and terminates in a narrow thickened fold (Fig. 3^a) on the posterior side armed along either edge and on the anterior side with a longitudinal series of slender spines or spiniform setæ, of which the distal one on the inner edge, the anterior series, and the distal ones of the outer series are very long. The anterior lobe of the scaphognath is long and very narrow, and projects considerably beyond the protognath, while the posterior lobe is large, broad, and curved strongly inward and anteriorly as in the allied genera.

The first maxillipeds (Pl. XV. fig. 7) resemble those of the typical species of *Penæus*. The distal lobe of the protopod is large, rounded in outline distally and about two and a half times as long as broad. The endopod is composed of three segments: the proximal segment is a little more than half the whole length, broad at base but narrow distally and with the inner margin abruptly contracted near the middle, leaving an angular projection which is armed with long setæ, while beyond this projection it is narrowed to near the extremity and is regularly curved inward round, and extends considerably beyond, the end of the protopod; the two distal segments are nearly straight, approximately equal in length, very narrow, and with a regular series of slender plumose setæ along either edge, those on the outer edge being much the larger. The exopod reaches to about the base of the distal segment of the endopod, is narrow, twelve to fifteen times as long as broad, but lamellar, and edged with a regular series of long plumose setæ. The epipod is small, but with a distinct anterior lobe, has a few hairs or setæ along the edges, and is apparently not branchial.

The endopod in the second maxilliped (Pl. XV. fig. 8) is large and stout: the ischium as usual is shorter than broad; the merus is as long as the entire protognath of the first maxilliped, and about a fourth as broad as long; the three distal segments are subequal in length and together about as long as the merus, the propodus about as wide as the merus, but the carpus and dactylus a little narrower; the dactylus is obtusely rounded and armed with a few strong spines distally, and both margins of the three distal segments and the inner margins of the proximal are clothed as usual with stout setæ and hairs. The exopod is very small, slender, nearly cylindrical, about as long as the merus, and the distal half multiarticulate, flagelliform, and furnished with small plumose setæ. The lamellar epipod is narrow-ovate, not bilobed distally, and bears a rather small dendrobranchia.

The external maxillipeds (Pl. XV. fig. 9) are very long and slender, though as thick as any of the legs, longer than the carapax and rostrum, and reach beyond the tips of the antennal scales fully the length of their dactyli: the ischium, merus, and carpus are approximately equal in length and subequal in diameter; the propodus and dactylus taper slightly and regularly; the propodus is fully two thirds and the dactylus half as long as the carpus; all the segments are thickly armed along the inner side with fascicles of exceedingly long and slender spines or stout setæ, and the three distal are similarly armed, but with shorter spines and setæ, on the other sides. The exopod is rudimentary and exceedingly minute, being very slender and much shorter than the diameter of the merus. The epipod is well developed, lanceolate, and undivided at the tip.

All the thoracic legs have very minute exopods, and all except the fifth pair have narrow and undivided epipods like the external maxillipeds. The first legs (Pl. XV. fig. 10) are about as long as the carapax excluding the rostrum, reach to the middle of the antennal scales, are slightly compressed, and stouter than the succeeding pairs: the merus is about twice as long as the ischium and

seven or eight times as long as broad ; the carpus is a third or fourth shorter than the ischium, but as broad ; the chela is slightly stouter than the carpus and only a little shorter, and has slightly curved digits about two thirds of the whole length ; the lower edges of the ischium, merus, and carpus are armed with fascicles of long spines and setæ as in the external maxillipeds, the upper edges of these segments and both edges of the chela are armed with much smaller spines or setæ, and in addition there is a small area densely covered with very short setæ or hairs near the distal end of the lower edge of the carpus, and a similar area in a corresponding position at the proximal end of the chela. The second legs are a half longer and much more slender than the first, nearly cylindrical, reach to the tips of the antennal scales, and are almost entirely naked. The third legs (Pl. XV. fig. 11) are like the second, but longer, reaching to the tips of the external maxillipeds. The chelæ of the second and third pairs are about as long as those of the first, but more slender, with proportionally shorter, straight and weak digits, and naked except for a few very minute hairs near the tips of the digits.

The fourth and fifth pairs of legs are exceedingly long and slender, and apparrently very nearly alike, but the distal segments are wanting in all the specimens seen ; the meri, however, reach to about the tips of the antennal scales in both pairs, but in the fifth pair a little farther than in the fourth ; and the parts which are preserved are almost entirely unarmed.

The branchiæ appear to be less densely branched than in the typical species of *Penæus*, and there are two arthrobranchiæ at the base of the penultimate leg each side instead of one, making nineteen branchiæ on each side arranged as indicated in the following table.

Somites.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.	Total.	
Epipods,	1	1	1	1	1	1	1	0		(7)
Podobranchiæ,	0	1	0	0	0	0	0	0	1	
Arthrobranchiæ,		2	2	2	2	2	2	0	12	
Pleurobranchiæ,	0	0	1	1	1	1	1	1	6	
									19	+(7)

The abdomen to the tip of the telson is slightly more than once and a half as long as the carapax including the rostrum, anteriorly nearly as broad as the carapax, but strongly compressed back of the third somite so that the sixth somite, which is nearly a fourth of the entire length of the abdomen and nearly twice as long as high, is nearly twice as high as broad. The three anterior somites are evenly rounded above, but the three posterior are sharply carinated, and on the fifth and sixth somites the carina terminates at the posterior margin in a small tooth. The epimera of all the somites are rather small, and have the posterior angles more or less rounded.

The telson is not quite perfect at the tip in any of the specimens, but is nearly three fourths as long as the sixth somite, narrowly triangular, thickened at base, has shallow dorsal and lateral sulci nearly the whole length, and the lower edge each side is armed near the tip with a slender spine.

The inner lamella of the uropod is slightly longer than the sixth somite, lanceolate, and about four times as long as broad. The outer lamella is just about as long and wide as the antennal scale, but is broader at the tip.

There are only three specimens in the collection, all apparently females, and all more or less imperfect. The largest specimen, from Station 323, gives the following measurements, which, on account of the soft condition of the specimen, are more or less approximate.

Length from tip of rostrum to tip of telson	42.0mm.
Length of carapax including rostrum	16.3
" rostrum	5.5
" antennal scale	8.0
" external maxilliped	19.0
" first pair of legs	12.0
" second pair of legs	18.0
" third pair of legs	22.0
" sixth somite of abdomen	6.2
Height of " " "	3.3
Length of inner lamella of uropod	6.5
Breadth " " "	1.6
Length of outer lamella of uropod	8.2
Breadth " " "	2.0

Possibly none of the specimens are fully grown, but all have apparently attained the characters of the adult. The smallest specimen, less than 30 mm. in length, does not differ, except in size, from the largest.

Station.	N. Lat.	W. Long.	Fathoms.
317	31° 57′ 0″	78° 18′ 35″	333
323	33° 19′ 0″	76° 12′ 30″	457
326	33° 42′ 15″	76° 0′ 50″	464

The genus *Penæus*, even after the subdivisions recently made by Bate, includes species differing widely in the structure of the articular appendages and in the arrangement of the branchiæ, but the genus here proposed appears to differ from all these species in the small and narrow terminal segment of the mandibular palpus, the rudimentary character of the exopods of the external maxillipeds and legs, the number and arrangement of the branchiæ, and the membranaceous character of the integument. From the typical species of *Penæus* it differs moreover in the short and unsegmented endognath of the first maxilla and in the sulcation and armament of the carapax. The species here described is possibly closely allied to, or even congeneric with, *Haliporus* Bate, which, however, is so imperfectly characterized, and the four species referred to it so briefly described, that it is impossible to determine its affinities with any certainty.

SERGESTIDÆ.

Sergestes arcticus Kröyer.

Oversigt Vidensk. Selsk. Forhandl. Kjöbenhaven, 1855, p. (6) ; Monograph. Sergestes, Vidensk. Selsk. Skr., V., Naturvidensk. mathem. Afh., IV. pp. 240, 276, Pl. III. figs. 7*a* – 7*g*, Pl. V. fig. 16, 1856.

Smith, Proc. National Mus., Washington, III. p. 445, 1881.

Plate XVI. Fig. 4.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
304	41° 35′ 0″	65° 57′ 30″	139	Fragments only.
309	40° 11′ 40″	68° 22′ 0″	304	1 ♀
326	33° 42′ 15″	76° 0′ 50″	464	1 ♂, 1 ♀
337	38° 20′ 8″	73° 23′ 20″	740	1 ♀, 55 mm. in length.

In this species there is an epipod and a well-developed podobranchia at the base of the second maxilliped, and above its base a simple lamella in place of a pleurobranchia, a large anterior pleurobranchia with a simple lamella back of it on each of the three succeeding somites, a large anterior and a small posterior pleurobranchia on the antepenultimate somite, and on the penultimate somite two small branchiæ, of which the posterior is very much the smaller, while the last somite is without branchiæ; or, indicating the simple pleurolamellæ by accents, the branchial formula* may be indicated as follows : —

Somites.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.	Total.
Epipods,	1	1	0	0	0	0	0	0	(2)
Podobranchiæ,	0	1	0	0	0	0	0	0	1
Arthrobranchiæ,	0	0	0	0	0	0	0	0	0
Pleurobranchiæ,	0	0′	1′	1′	1′	2	2	0	7
									8+(2)

* Boas (Studier over Decapodernes Stægtskabsforhold, Vidensk. Selsk. Skr., VI., Natuvidensk. mathem. Afh., I., 1880), for *S. Frisii* Kröyer, gives an epipod and a rudimentary *arthrobranchia* for the eighth somite and a single pleurobranchia for each of the succeeding somites *including the last*. Bate (Ann. Mag. Nat. Hist., 5th ser., VIII. p. 193, 1881), gives, for the genus *Sergestes*, a "mastibranchia" (epipod) and one *pleurobranchia* for the eighth somite, a single pleurobranchia for the ninth, a pleurobranchia and pleurolamella each for the tenth, eleventh, and twelfth, two pleurobranchiæ for the thirteenth, and nothing for the last ; but under *S. Kröyeri* he says, "This species has two well-developed pleurobranchiæ attached to the penultimate somite of the percion, two to the antepenultimate, one plume and a leaflike plate to the next three somites, and one plume and a rudimentary mastibranchial plate to the first pair of gnathopoda" (second maxillipeds). This last statement of Bate would apparently indicate an arrangement of the branchiæ much like that which I have given above, or even nearer to that of *S. robustus* described beyond, but it is very unlike the arrangement indicated by his formula for the genus.

The structure of the branchiæ themselves, in this and in the two following species as well, is very different from that in *Penæus*, or any of the Penæidæ described in this paper. The branchiæ are pinnate in form, and each pinna is a complete phyllobranchia ; that is, they are compound phyllobranchiæ, while those of *Penæus* are compound trichobranchiæ. The structure is more like that in *Sicyonia* (judging by Bate's description of the branchiæ of that genus) than that in *Penæus*.

The first pair of thoracic legs are subchelate, and the dactyli of the external maxillipeds and the propodi of the first, second, and third pairs of legs are multiarticulate, as in the next species, the articulations being more conspicuous than in that species. These structural characters of the thoracic legs are, however, undoubtedly characteristic of all the species of the genus.

[Sergestes robustus, sp. nov.

Plate XVI. Figs. 5-8^{b}.

Male. — The carapax is strongly compressed, the breadth being considerably more than the height at the base of the antennæ, but much less than the greatest height posteriorly, which is rather more than twice that at the base of the antennæ. The dorsum is broadly rounded to the base of the rostrum, which rises rather abruptly from the dorsum, is very thin, acutely triangular, and extends a little forward of the truncated middle lobe of the ophthalmic somite.

The eyestalks to the tips of the eyes are about two fifths as long as the antennal scales, and the diameter of the eye itself about half the length. The peduncle of the antennula is about a fifth longer than the antennal scale, the first segment scarcely half as long as the antennal scale, and the second and third successively a little shorter ; all the segments are very stout, the diameter in the second and third being equal to more than half the length. The proximal segment of the upper or major flagellum is scarcely more than a fourth as long as the distal segment of the peduncle, and scarcely longer than the proximal segment of the lower flagellum, which is modified as in the allied species. The antennal scale (Fig. 7) is about half as long as the carapax along the dorsal line, about a third as broad as long, and much broader at the tip than in the allied species.

The oral appendages do not differ essentially from the oral appendages of *P. Frisii* and *arcticus* as figured by Kröyer.

The external maxillipeds reach by the tips of the antennal scales fully the length of their dactyli, and are about as stout as the third pair of legs : all five segments of the endopod are approximately equal in length though the dactylus is slightly shorter than the others, and all are armed with very slender spines ; the dactylus is slender and multiarticulate, being composed of about five segments, and tipped with two or three spines. The legs of the first pair fall a little short of the tips of the antennal scales : the merus is about twice as long as the carpus and about as long as the propodus, which is very slender, com-

posed of about ten segments, and armed, like the ischium, merus, and carpus, with exceedingly long, and for the most part simple, setiform spines, and at the proximal extremity with a tuft of serrate setæ corresponding to a similar tuft on the distal extremity of the propodus ; the dactylus is very minute, but perfectly distinct, and armed with an exceedingly long and slender spiniform seta, while the tip of the propodus is armed with a very much shorter spine. The legs of the second pair reach to about the tips of the external maxillipeds : the merus is a little longer than in the first pair ; the carpus twice as long as in the first pair and only a little shorter than the merus ; the propodus is longer than the merus, composed of about twelve segments, and armed very nearly as in the first pair, except that the tuft of setæ at the proximal extremity, with the corresponding one on the carpus, is wholly wanting, while the digits of the well-developed chela (Fig. 6) are considerably longer than the diameter of the propodus at their base, slender, nearly straight, and armed at the tips with a dense brush of setæ, most of which are serrate. The legs of the third pair are almost exactly like those of the second, except that they are considerably longer, reaching by the second pair by about half the length of their dactyli. The legs of the fourth pair reach nearly to the tips of the carpi of the third pair and are very much stouter, and the endopods are composed of only four segments each, the dactylus, apparently, being wanting : the ischium, carpus, and propodus (or the proximal and the two distal segments) are subequal in length, while the merus (or antepenultimate segment) is about once and a half as long as each of the others : the merus is about six times as long as broad, and, like the ischium, densely ciliated along both edges, but the cilia on the lower edge are several times longer than those upon the upper, which are not as long as the breadth of the segment ; the carpus is slightly broader than the merus, being more than a fourth as broad as long, ciliated like the merus along the lower edge, but the upper edge naked ; the propodus (or ultimate segment) is a little less than a fifth as broad as long, ovate at the tip, and has the lower edge ciliated and the upper naked like the carpus. The legs of the fifth pair are a little more than half as long as those of the fourth, and their endopods are composed of the same number of segments : the ischium and carpus are subequal in length, the merus a little longer, and propodus a little shorter, and all the segments are ciliated along both edges, though the cilia upon the lower edge are much longer than those upon the upper ; the merus is about a fourth as broad as long, and considerably broader than the ischium or carpus ; the carpus is less than a fourth as broad as long, and slightly tapered distally ; the propodus is a little less than a fifth as broad as long, and regularly tapered from near the base to the acute tip.

The abdomen, excluding the telson, is nearly twice as long as the carapax along the dorsal line, is considerably compressed, though anteriorly about as broad as the carapax, and, like the carapax, rounded above, but with a shallow median sulcus on each of the first four somites, inconspicuous on the first and second, but distinct on the third and fourth. [There are similar sulci on the abdomen of *S. arcticus*, and they are possibly, though apparently not, due to

contraction from preservation in strong alcohol.] The epimera of the first three somites are large and project backward in an angle, while the epimera of the fourth and fifth somites project backward quite as far, but have the outline more rounded. The sixth somite is about as long as the antennal scale, considerably more than half as high as long, and strongly compressed.

The telson is considerably shorter than the sixth somite, flattened and slightly sulcated above, with a deep lateral groove each side, acutely angular at the tip, and ciliated along the edges. The inner lamella of the uropod is a little longer than the telson, about three and a half times as long as broad, and lanceolate at the tip. The outer lamella is between a third and a fourth longer than the inner, less than a fourth as broad as long, the outer margin terminating in a strong tooth about two thirds of the way from the base to the tip, and the tip narrow, but rounded.

The peculiar sexual appendages (petasma, Fig. 8) of the first somite of the abdomen have essentially the same structure as in *S. arcticus*, but are much more complicated than would be inferred from the figures for that species given by Kröyer. The appendages of the two sides are usually hooked together along the middle line (*h*), but are really entirely distinct. Each is attached by a narrow process (*a*) to the protopod of the abdominal appendage, and is divided by more or less distinct sutures into three portions. The outer portion, that next the protopod, projects above the point of attachment in a narrow process, and below the point of attachment in a broad lamellar lateral expansion, and below this in a long, flat, chitinous stylet (*b*) terminating in a sharp hook below a rounded sinus in the extremity. The middle portion projects below and alongside of, but far beyond, the hooked stylet (*b*), in a complicated appendage divided distally into three membranaceous and hook-bearing processes (*e, f, g*) and bearing two slender and unarmed stylets (*c, d*) ; and each of the membranaceous processes is armed along one edge with a series of peculiar chitinous hooks retracted within invaginated papillæ (Fig. 8^b), and at the tip with a larger and somewhat differently shaped but similarly retracted hook (Fig. 8^a). The lateral hooks themselves are semi-mushroom-shaped, like those which serve to hook together the inner rami of the abdominal appendages in many crustaceans, and very much like those along the mesial edge (*h*) of this same appendage, but larger. The terminal hooks are more properly hook-shaped, as shown in the figure, but are broad at the tips. The invagination of the membrane around the hooks is possibly due to contraction in the alcoholic specimens, but the hooks are similarly retracted in all the specimens of *S. arcticus* which I have examined, their bases appear to be connected with strong muscular fibres, and I think there is little doubt that the hooks are capable of being retracted in life. The mesial portion of appendages is thin, lamellar, longitudinally folded, and armed along the mesial edge with great numbers of semi-mushroom-shaped hooks which serve to attach together the appendages of the two sides.

The branchiæ are the same in number and have the same arrangement as in *S. arcticus*, but the posterior branchia on the twelfth (antepenultimate) somite

is nearly as large as the anterior, which is the largest of the series, and the branchiæ of the penultimate segment are very nearly alike, and not very much smaller than the pair next in front of them.

I have seen only four specimens, all males, and but one of these is in the "Blake" collection ; this one from Station 328, N. Lat. 34° 28′ 25″, W. Long. 75° 22′ 50″, 1632 fathoms. The other specimens are from the collections made by the U. S. Fish Commission off Martha's Vineyard : Stations 893 and 952, 372 and 388 fathoms.

Two specimens give the following measurements : —

Station	893	328
Sex	♂	♂
Length from tip of rostrum to tip of telson	58.0 mm.	65.0 mm.
" of carapax along dorsal line	17.8	19.5
" of rostrum	1.2	1.3
Height of carapax anteriorly	4.0	4.5
" " posteriorly	8.5	9.5
Breadth of carapax	5.6	6.3
Length of eyestalk and eye	3.5	3.9
Diameter of eye	1.7	1.9
Length of antennal scale	9.0	9.2
Breadth of antennal scale	2.9	1.3
Length of sixth somite of abdomen	9.0	10.0
" telson	7.5	8.0
" inner lamella of uropod	8.0	8.3
" outer " "	11 0	12.0

This is the species which I have referred to as "Sergestes sp." in Proc. National Mus., Washington, III. p. 445, 1881.

Sergestes, sp. indet.

There are specimens of a third species of *Sergestes* from Station 328, N. Lat. 34° 28′ 25″, W. Long. 75° 22′ 55″, 1632 fathoms, and fragments of apparently the same species from Station 325, N. Lat. 33° 35′ 20″, W. Long. 76°, 647 fathoms. These specimens are all in bad condition and want a large part of the appendages, but they are interesting on account of the modification of the branchial formula. The branchiæ are all much smaller than in *S. robustus*, the posterior pleurobranchia of the twelfth (antepenultimate) somite is replaced by a simple lamella like that upon the somite next in front, and the two branchiæ of the penultimate somite are very small, as in *S. arcticus*. The species is apparently even larger than *S. robustus*, and much like it in general appearance, but the rostrum is much smaller and apparently obtuse, and the eyes are very small, scarcely larger than eyestalks. The specimens are all females.

EXPLANATION OF THE PLATES.

All the figures on Plates I., III., and V.; Figs. 1 to 4^{b}, 5, Plate II.; Fig. 1, Plate IV.; Figs. 1, 2, 3, Plate VI.; Figs. 1, 1^{a}, 1^{b}, 2, 2^{a}, 4, 4^{a}, 5, 5^{a}, Plate VII.; Figs. 1, 1^{a}, 1^{b}, 2, Plate VIII.; Figs. 1, 2, 2^{a}, Plate IX.; Figs. 1, 2, Plate X.; Figs. 4, 5, 8, Plate XI.; Fig. 1, Plate XIII.; and Fig. 5, Plate XVI., were drawn by J. H. Emerton. All the other figures were drawn by the author.

PLATE I.

Fig. 1. *Lithodes Agassizii.* Dorsal view of female from Station 329, half natural size.

" 2. Dorsal view of a young specimen taken off Martha's Vineyard by the U. S. Fish Commission, Station 1029, enlarged two diameters.

" 2^{a}. Lateral view of the carapax of the same specimen, enlarged two diameters.

PLATE II.

Fig. 1. *Cyclodorippe nitida* A. Milne-Edwards. Dorsal view of female, enlarged two diameters.

" 1^{a}. Front view of same specimen, enlarged four diameters.

" 1^{b}. Ventral view of same specimen, the distal portions of the legs omitted, enlarged four diameters.

" 2. *Amathia Agassizii.* Dorsal view of the carapax of the male from Station 319, natural size.

" 3. Dorsal view of a young specimen from Station 317, enlarged two diameters.

" 4. *Parapagurus pilosimanus* Smith. Lateral view of the left side of the originally described male specimen, taken on a trawl line, off Nova Scotia, half natural size.

" 4^{a}. Dorsal view of the chelipeds of the same specimen, half natural size.

" 4^{b}. Dorsal view of the carapax and anterior appendages of the same specimen, natural size.

" 4^{c}. Appendage of the right side of the first somite of the abdomen of the same specimen, seen from behind, enlarged four diameters.

" 4^{d}. Appendage of the right side of the second somite of the abdomen of the same specimen, seen from behind, enlarged four diameters.

" 5. *Eupagurus politus.* Lateral view of left side of male, dredged by the U. S. Fish Commission off Martha's Vineyard, Station 922, natural size.

PLATE III.

Fig. 1. *Pentacheles sculptus* Smith. Dorsal view of female, from Station 326, natural size.

PLATE IV.

Fig. 1. *Pentacheles sculptus* Smith. Ventral view of the cephalo-thorax of the specimen figured on the last plate, the distal portions of the appendages omitted, natural size ; *a*, tubular process containing the canal of the green gland ; *b*, process of the ophthalmic lobe.

" 2. Mandible and lobe of metastome of the right side, as seen in place from below, from the male from Station 326, enlarged about two diameters.

" 2ª. Palpus of the same mandible, seen from below, enlarged about two diameters.

" 3. First maxilla of the right side of the same specimen, seen from below, enlarged about two diameters.

" 4. Second maxilla of the right side of the same specimen, seen from below, enlarged about two diameters.

" 5. Diagrammatic outline of the anterior portion of the first maxilliped of the right side of the same specimen, as seen in place from below, enlarged about two diameters ; *a*, proximal, and *a'*, distal lobe of the protopod ; *b*, base of endopod, the terminal portion being entirely hidden by the exopod ; *c*, basal portion of the exopod ; *d*, *e*, terminal lobes of the exopod.

" 5ª. The same maxilliped removed from the animal, slightly compressed and seen from a little one side and below, enlarged about two diameters ; *a*, *a'*, *b*, *c*, *d*, same as in last figure ; *f*, *g*, epipodal lamella.

" 5ᵇ. Terminal portion of the same maxilliped, seen from above under slight pressure, enlarged about two diameters ; lettering the same as in figures 5, 5ª.

" 6. Second maxilliped of the right side of the same specimen, enlarged about two diameters.

" 7. External maxilliped of the right side of the same specimen, enlarged two diameters ; *a*, rudimentary epipod.

" 8. Chela of the right great cheliped of the female figured on Plate III., natural size.

" 9. Chela of the right leg of the second pair of the male from Station 326, enlarged about two diameters.

" 10. Rudimentary chela of the right leg of the third pair of the same specimen, enlarged about two diameters.

" 11. Rudimentary chela of the right leg of the fifth pair of the same specimen, enlarged about two diameters.

" 12. Rudimentary chela of the right leg of the fifth pair of the female from Station 898, U. S. Fish Commission, enlarged about two diameters.

" 13. Appendage of the left side of the first somite of the abdomen of the female figured on Plate III., enlarged about two diameters.

" 14. Appendage of the left side of the first somite of the male from Station 326, enlarged about two diameters.

PLATE V.

Fig. 1. *Rhachocaris longirostra.* Lateral view of female from Station 330, enlarged two diameters.

" 2. *Rhachocaris Agassizii.* Lateral view of female from Station 326, natural size.

" 3. *Rhachocaris sculpta.* Lateral view of female from Station 339, natural size.

PLATE VI.

Fig. 1. *Rhachocaris longirostra.* Dorsal view of carapax and anterior appendages of the specimen figured on Plate V., enlarged two diameters.

" 2. *Rhachocaris Agassizii.* Dorsal view of the specimen figured on Plate V., natural size.

" 3. *Rhachocaris sculpta.* Dorsal view of the specimen figured on Plate V., natural size.

" 3ª. First maxilla of the right side of the same specimen enlarged six diameters.

" 3ᵇ. Second maxilla of the right side of the same specimen, enlarged four diameters.

" 3ᶜ. First maxilliped of the right side of the same specimen, enlarged six diameters.

" 3ᵈ. Second maxilliped of the right side of the same specimen, enlarged four diameters.

PLATE VII.

Fig. 1. *Pontophilus brevirostris* Smith. Dorsal view of adult female, enlarged two diameters.

" 1ª. Lateral view of the carapax of the same specimen, enlarged two diameters.

" 1ᵇ. Dorsal view of rostrum of the same specimen, enlarged eight diameters.

" 2. *Pontophilus gracilis.* Dorsal view of female, enlarged two diameters.

" 2ª. Lateral view of the carapax of the same specimen, enlarged two diameters.

" 2ᵇ. Appendage of the left side of the first somite of the abdomen of the same specimen, enlarged eight diameters.

" 2ᶜ. Appendage of the left side of the second somite of the abdomen of the same specimen, enlarged eight diameters.

" 3. Appendage of the left side of the first somite of the abdomen of a male taken off Martha's Vineyard by the U. S. Fish Commission, Station 1029, enlarged eight diameters.

" 3ª. Appendage of the left side of the second somite of the abdomen of the same specimen, enlarged eight diameters.

" 4. *Ceraphilus Agassizii.* Dorsal view of female from Station 326, natural size.

" 4ª. Lateral view of the carapax of the same specimen, natural size ; *a*, anterior gastric spine ; *b*, rostrum ; *c*, orbital spine ; *d*, antero-lateral angle.

" 5. Lateral view of carapax and abdomen of a male from Station 317, enlarged two diameters ; *a*, *b*, *c*, *d*, the same as in fig. 4ª.

" 5ª. Dorsal view of carapax of the same specimen, enlarged two diameters ; *a*, *c*, *d*, the same as in fig. 4ª.

PLATE VIII.

Fig. 1. *Sabinea princeps.* Lateral view of female, natural size.
" 1ª. Dorsal view of carapax and anterior appendages of the same specimen, natural size.
" 1ᵇ. Dorsal view of the terminal portion of the abdomen of the same specimen, natural size.
" 2. *Munidopsis curvirostra* Whiteaves. Dorsal view of male from Station 325, enlarged four diameters.
" 3. Appendage of the right side of the first somite of the abdomen of a male, from 220 fathoms, Gulf of St. Lawrence, enlarged eight diameters.
" 3ª. Appendage of the right side of the second somite of the same specimen, enlarged eight diameters.

PLATE IX.

Fig. 1. *Anchistia tenella.* Lateral view of female, enlarged four diameters.
" 1ª. Dorsal outline view of right eye and peduncle of antennula of the same specimen, enlarged eight diameters.
" 1ᵇ. Outline of left antennal scale of the same specimen, enlarged eight diameters.
" 2. *Galacantha rostrata* A. Milne-Edwards. Dorsal view of male from Station 341, natural size.
" 2ª. Lateral view of carapax of the same specimen, natural size.

PLATE X.

Fig. 1. *Munida* sp. indet. Dorsal view of a large male, taken by the U. S. Fish Commission off Martha's Vineyard, Station 877, natural size.
" 2. *Pandalus carinatus.* Lateral view of female, enlarged two diameters.
" 2ª. First maxilliped of the right side of the same specimen, seen from beneath, enlarged twelve diameters.
" 2ᵇ. Second maxilliped of the right side of the same specimen, enlarged twelve diameters.
" 2ᶜ. Distal portion of right chelate leg of the same specimen, enlarged twelve diameters.
" 2ᵈ. Lamellæ of the appendage of the left side of the first somite of the abdomen of the same specimen, seen from behind, enlarged twelve diameters ; the marginal setæ and the distal portion of the outer lamella omitted.
" 2ᵉ. Outline of tip of outer lamella of right uropod of the same specimen, enlarged four diameters.
" 2ᶠ. Tip of telson of same specimen, seen from above, enlarged twenty-four diameters.

PLATE XI.

Fig. 1. *Pandalus carinatus.* Right mandible of the specimen figured on Plate X., seen from in front, enlarged twelve diameters.
" 2. Right first maxilla of the same specimen, seen from beneath, enlarged twelve diameters.

Fig. 3. Right second maxilla of the same specimen, seen from beneath, enlarged twelve diameters.

" 4. *Miersia graeilis.* Lateral view of young male, enlarged two diameters.

" 4ª. Distal extremity of the posterior leg of the left side of the same specimen, enlarged eight diameters.

" 4ᵇ. Rami of the appendage of the right side of the first somite of the abdomen of the same specimen, seen from behind, enlarged eight diameters ; the marginal setæ of the outer ramus omitted.

" 4ᶜ. Portion of the base of the inner lamella of the appendage of the right side of the second somite of the abdomen of the same specimen, seen from behind and showing the small secondary stylet characteristic of the male, enlarged twenty-four diameters.

" 4ᵈ. Distal part of the second maxilliped of the right side of the same specimen, seen from below, enlarged eight diameters.

" 5. *Miersia Agassizii.* Lateral view of male from Station 330, natural size.

" 5ª. Second maxilliped of the left side of the same specimen, seen from below, enlarged eight diameters.

" 6. Distal extremity of the posterior leg of the right side of a male from Station 305, enlarged twelve diameters.

" 7. Inner lamella of the appendage of the left side of the same specimen, seen from in front, enlarged eight diameters.

" 8. *Meningodora mollis.* Lateral view of female, natural size. The lateral carinæ of the carapax are indicated by simple lines.

" 8ª. Outline of the right eye of the same specimen, seen from above, enlarged two diameters.

" 9. Second maxilliped of the right side of the same specimen, seen from below, enlarged eight diameters.

PLATE XII.

Fig. 1. *Miersia Agassizii.* Distal portion of the left mandible of the specimen figured on Plate XI. fig. 5, seen from beneath.

" 1ª. The same mandible seen from above.

" 2. First maxilla of the left side of the same specimen, seen from beneath.

" 3. Second maxilla of the left side of the same specimen, seen from beneath.

" 4. First maxilliped of the left side of the same specimen, seen from beneath.

" 5. *Meningodora mollis.* Distal portion of the right mandible of the specimen figured on Plate XI. fig. 8, seen from beneath.

" 5ª. The same mandible seen from above.

" 6. First maxilla of the right side of the same specimen, seen from beneath.

" 7. Second maxilla of the right side of the same specimen, seen from beneath.

" 8. First maxilliped of the right side of the same specimen, seen from beneath.

" 9. Distal extremity of posterior leg of the same specimen, enlarged twenty-four diameters.

" 10. *Miersia gracilis.* Endopod and exopod of the second maxilliped of the right side of the specimen figured on Plate XI. fig. 4.

All the figures, except Fig. 9, are enlarged eight diameters.

PLATE XIII.

Fig. 1. *Eumicrsia ensifera.* Lateral view of female from Station 340, natural size.
" 2. Mandible of the left side of another female of about the same size and from the same station, seen from beneath, enlarged four diameters.
" 2a. The same mandible seen from behind, enlarged four diameters.
" 3. First maxilla of the left side of the same specimen, seen from beneath, enlarged four diameters.
" 4. Second maxilla of the left side of the same specimen, seen from beneath, enlarged four diameters.
" 5. First maxilliped of the left side of the same specimen, seen from beneath, enlarged four diameters.
" 6. Second maxilliped of the left side of the same specimen, seen from beneath, enlarged four diameters.
" 7. Distal extremity of right chelate leg of the first pair of a male 44 mm. long from Station 330, enlarged about eight diameters.
" 8. Distal extremity of right chelate leg of the second pair of the same specimen, enlarged eight diameters.
" 9. Distal extremity of left leg of the fifth (?) pair of a female 108 mm. long from Station 308, enlarged four diameters.
" 10. *Pandalus acanthonotus.* Carapax and anterior appendages of the female from Station 321, enlarged four diameters.
" 11. Propodus and dactylus of the second maxilliped of the right side of the same specimen, seen from beneath, enlarged twelve diameters
" 12. *Pandalus tenuipes* Smith. Same part of second maxilliped of a specimen from 115 fathoms, off Martha's Vineyard (U. S. Fish Commission, Station 871), enlarged twelve diameters.

PLATE XIV.

Fig. 1. *Benthesicymus Bartlettii.* Diagrammatic sketch of the left side of the male, with most of the appendages omitted, natural size.
" 1a. Similar dorsal view of the anterior part of the carapax and the anterior appendages of the same specimen, natural size.
" 2. Distal part of the mandible of the left side of the same specimen, seen from beneath, enlarged six diameters.
" 3. First maxilla of the left side of the same specimen, seen from beneath, enlarged six diameters.
" 4. Second maxilla of the left side of the same specimen, seen from beneath, enlarged six diameters.
" 5. First maxilliped of the left side of the same specimen, seen from beneath, enlarged four diameters.
" 6. Second maxilliped of the left side of the same specimen, seen from beneath, enlarged four diameters.
" 7. Appendage (petasma) of the protopod of the appendage of the left side of the first somite of the abdomen, seen from in front, enlarged twelve diameters; *a*, process standing out, in its natural position, at nearly

right angles to the rest of the plate, but here represented as compressed nearly to the plane of the plate.

Fig. 8. *Amalopenæus elegans.* Diagrammatic sketch of the left side of the carapax and anterior appendages of a female from Station 328, enlarged about two diameters.

" 9. Mandibular palpus of the left side of the same specimen, seen from beneath, enlarged eight diameters.

" 10. Endognath of the first maxilla of the left side of the same specimen, seen from beneath, enlarged eight diameters.

" 11. Second maxilla of the left side of the same specimen, seen from beneath, enlarged eight diameters.

" 12. Outline of the antennal scale of the left side of the same specimen, seen from above, enlarged nearly four diameters.

" 13. Appendage (petasma) of the protopod of the appendage of the left side of the first somite of a male from Station 324, seen from in front, enlarged twelve diameters; *a*, process below the base; *b*, process between the middle and inner or distal parts of the plate, and which turns readily either in or out.

" 14. Same appendage from a specimen from Station 330, seen in the same position, enlarged twelve diameters; *a*, *b*, as in Fig. 13.

PLATE XV.

Fig. 1. *Amalopenæus elegans.* First chelate leg of the right side of the female figured on Plate XIV. fig. 8, enlarged about eight diameters.

" 2. Second chelate leg of the left side of the same specimen, enlarged about eight diameters.

" 3. First maxilliped of the left side of the same specimen, seen from beneath, enlarged eight diameters.

" 4. Second maxilliped of the left side of the same specimen, seen from beneath, enlarged eight diameters.

" 5. External maxilliped of the left side of the same specimen, enlarged four diameters.

" 5a. Distal extremity of the same maxilliped, enlarged twenty-four diameters.

" 6. *Hymenopenæus debilis.* Diagrammatic sketch of the left side of the carapax and anterior appendages of a female from Station 323, enlarged about two diameters.

" 7. First maxilliped of the left side of a female from Station 326, seen from beneath, enlarged eight diameters.

" 8. Second maxilliped of the left side of the same specimen, seen from beneath, enlarged eight diameters.

" 9. External maxilliped of the left side of the same specimen, enlarged four diameters.

" 10. First chelate leg of the right side of the same specimen, enlarged four diameters.

" 11. Distal part of the third chelate leg of the right side of the same specimen, enlarged four diameters.

PLATE XVI.

Fig. 1. *Hymenopenæus debilis.* Mandibular palpus of the left side of the female from Station 326, seen from beneath, enlarged eight diameters.

" 2. First maxilla of the left side of the same specimen, seen from beneath, enlarged eight diameters.

" 2ª. Tip of endopod of the same maxilla, enlarged twenty-four diameters.

" 3. Second maxilla of the left side of the same specimen, seen from beneath, enlarged eight diameters.

" 3ª. Tip of the endopod of the same maxilla, enlarged seventy-two diameters.

" 4. *Sergestes arcticus* Kröyer. Antennal scale of the right side of a male from off Martha's Vineyard, U. S. Fish Commission, Station 1030, enlarged four diameters.

" 5. *Sergestes robustus.* Lateral view of male from off Martha's Vineyard, U. S. Fish Commission, Station 893, enlarged two diameters.

" 6. Distal extremity of chela of the second leg of the left side of another male from the same station, enlarged twenty-four diameters.

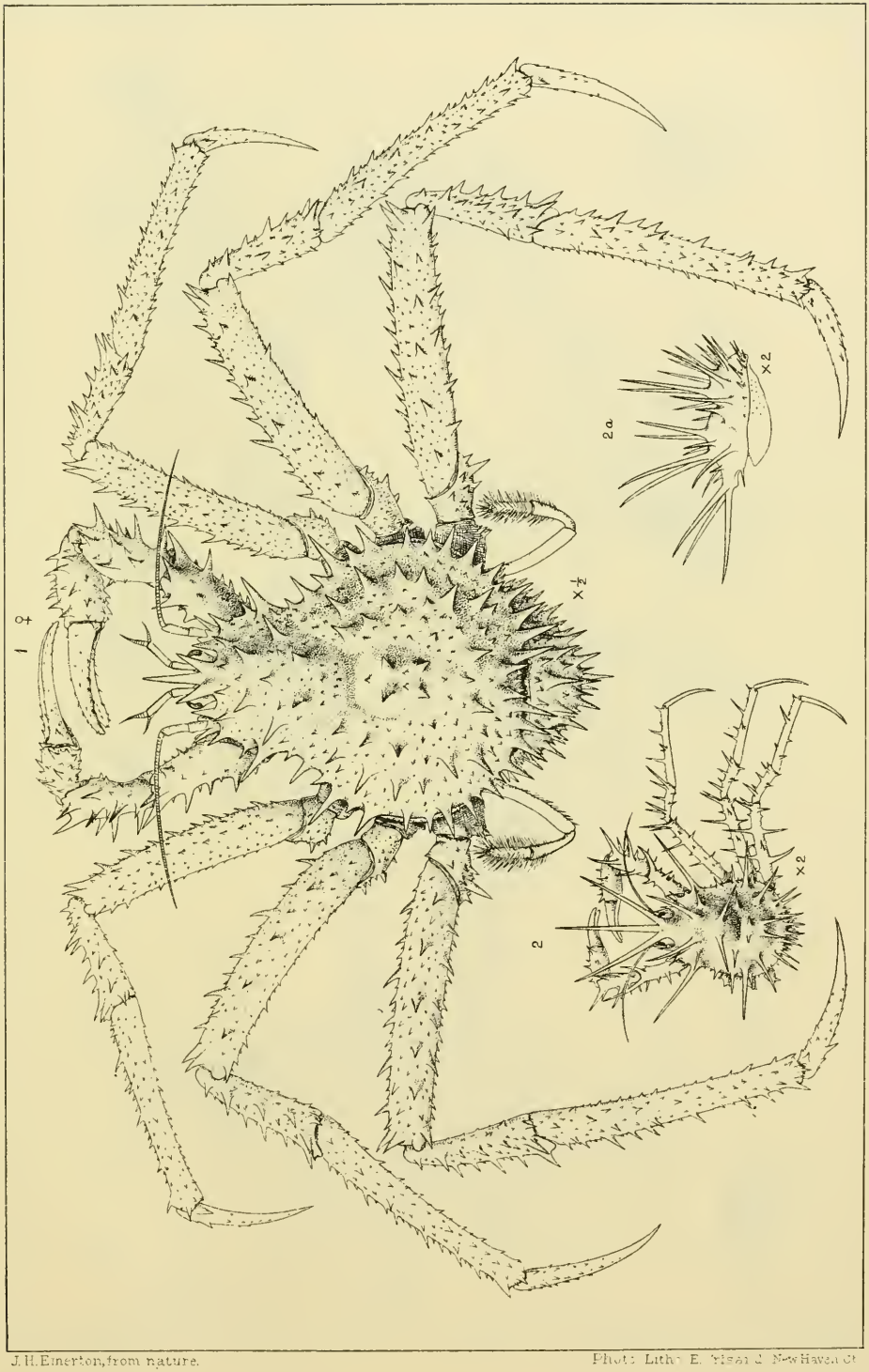
" 7. Antennal scale of the right side of the same specimen, enlarged four diameters.

" 8. Appendage (petasma) of the protopod of the appendage of the right side of the first somite of the same specimen, seen from in front, enlarged eight diameters ; *a*, point of attachment to the protopod ; *b*, hooked stylet ; *c*, *d*, unarmed stylets; *e*, *f*, *g*, terminal processes armed with invaginated hooks ; *h*, mesial line where the appendages of the two sides are hooked together.

" 8ª. Invaginated hook at the tip of process *f*, enlarged one hundred diameters.

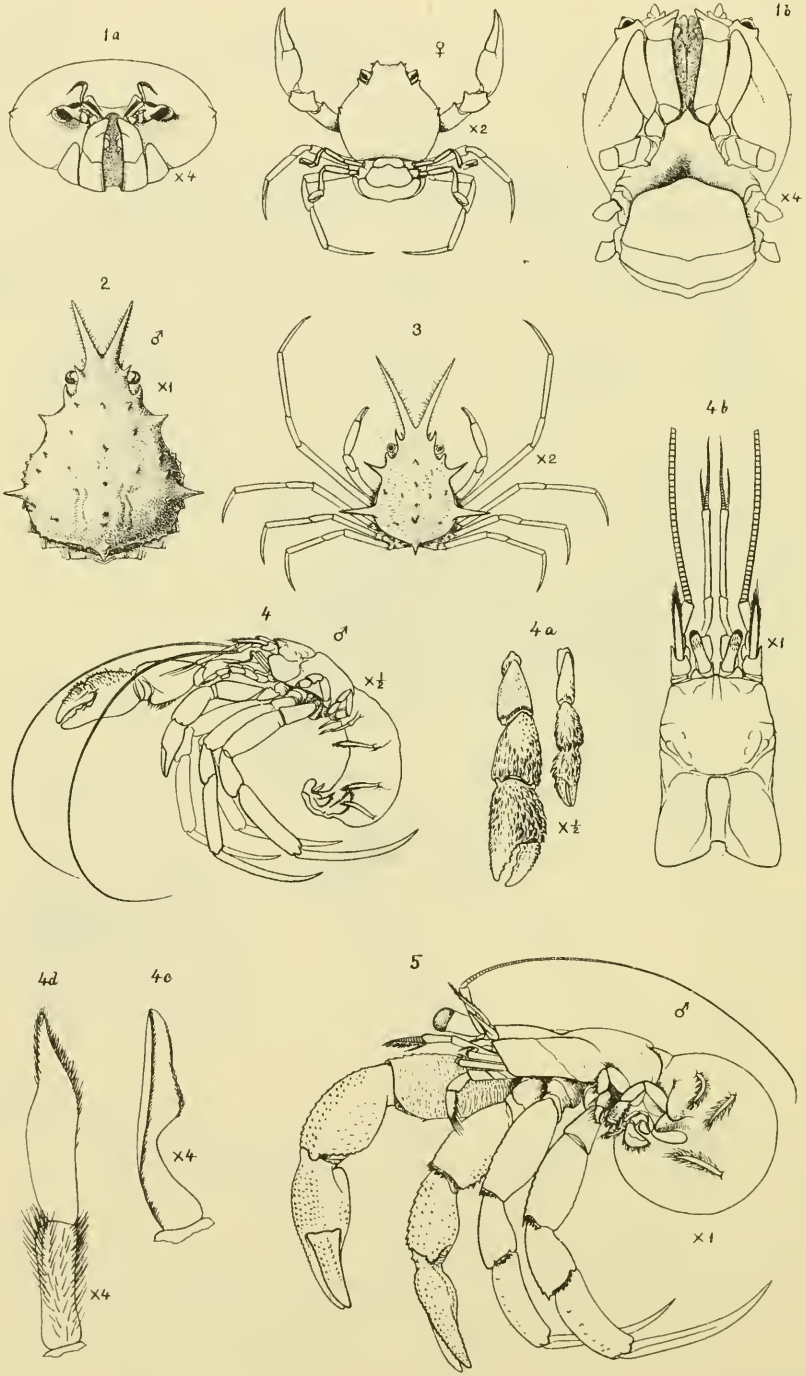
" 8ᵇ. Invaginated hook from the side of the same process, enlarged one hundred diameters.

New Haven, Conn., June, 1882.



J. H. Emerton, from nature. Photo-Lith. E. Yisel & J. New Haven Ct.

LITHODES AGASSIZII.



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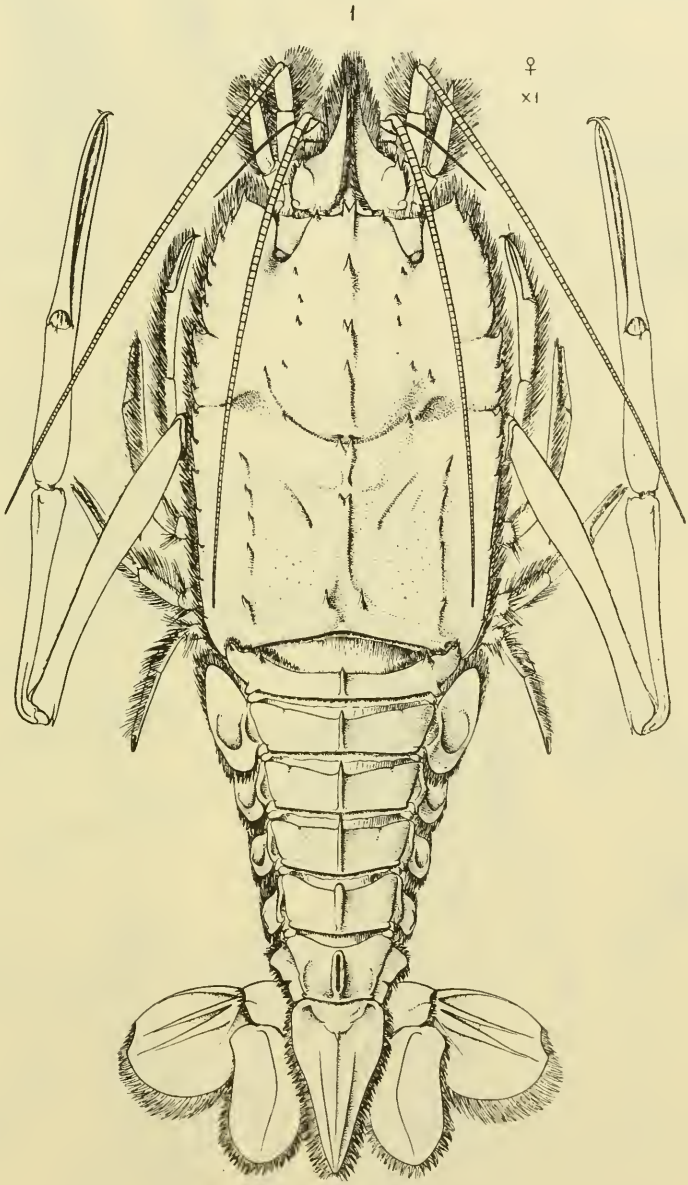
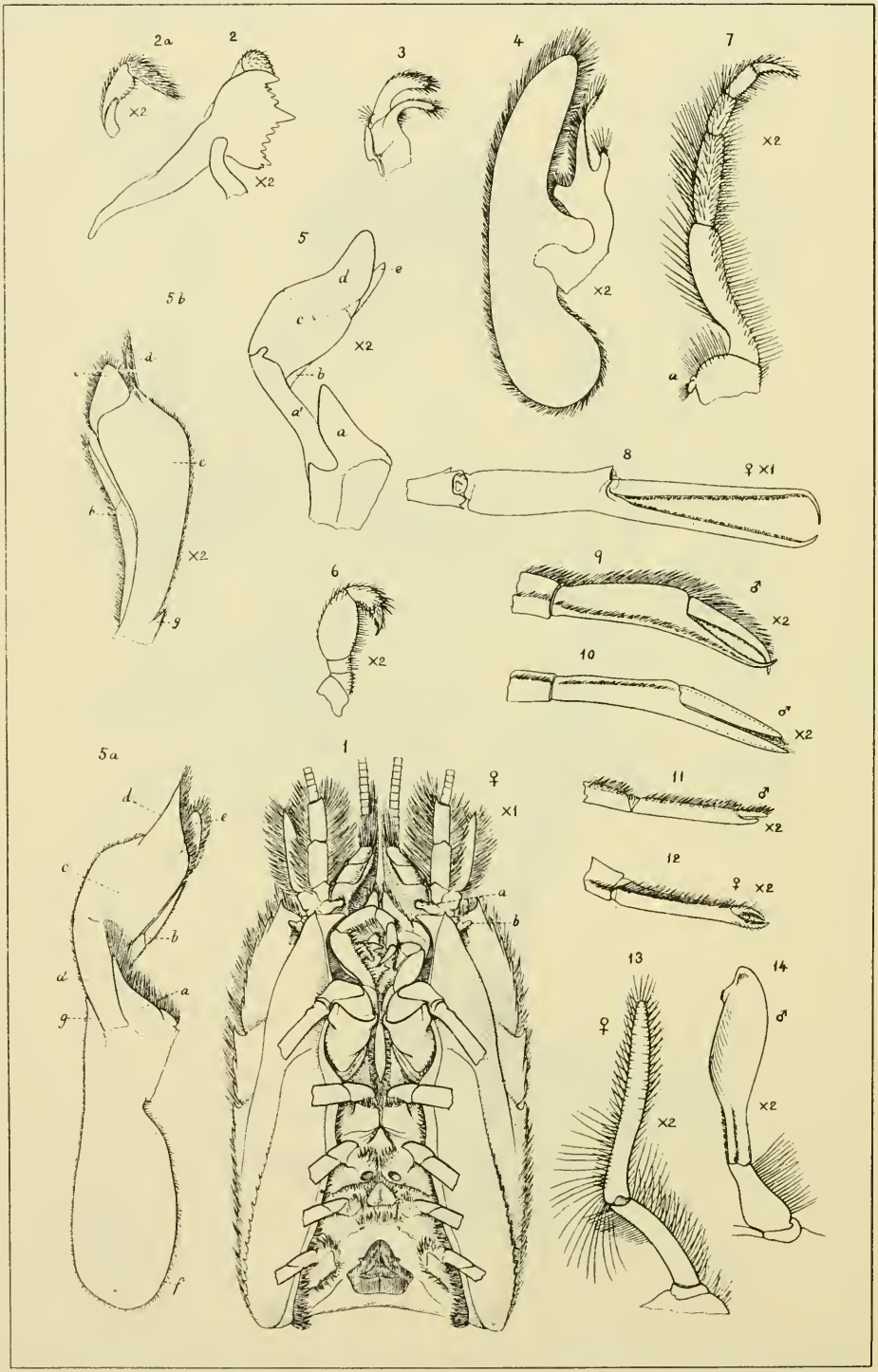
CYCLODORIPPE, AMATHIA, PARAPAGURUS, EUPAGURUS.



J. H. Emerton, from nature

Photo. Lith. J. E. Nissen & Co. New Haven, Ct.

PENTACHELES SCULPTUS.



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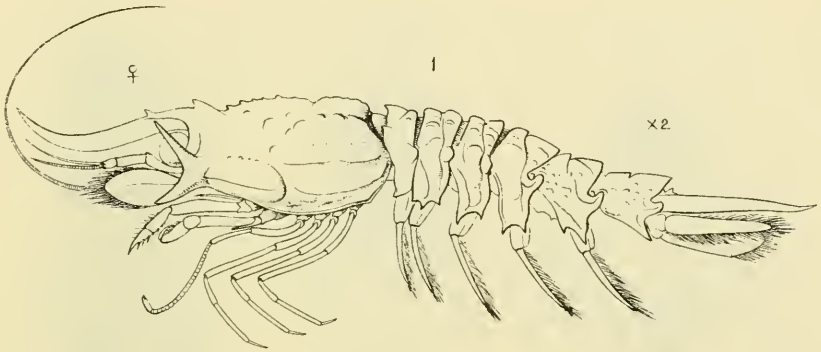
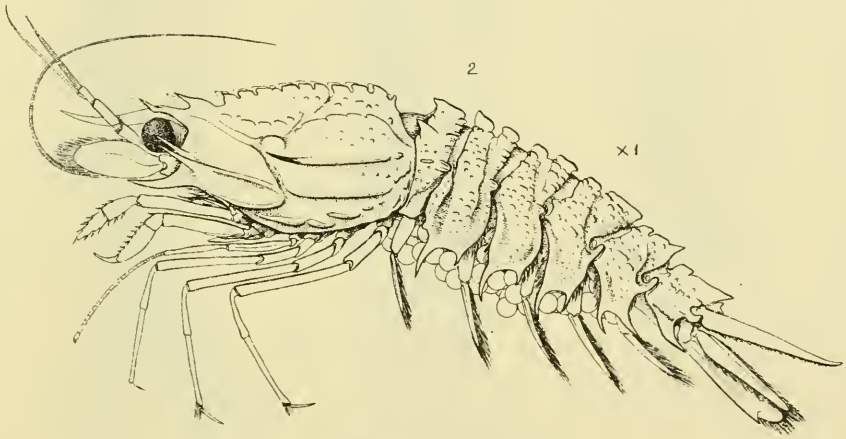




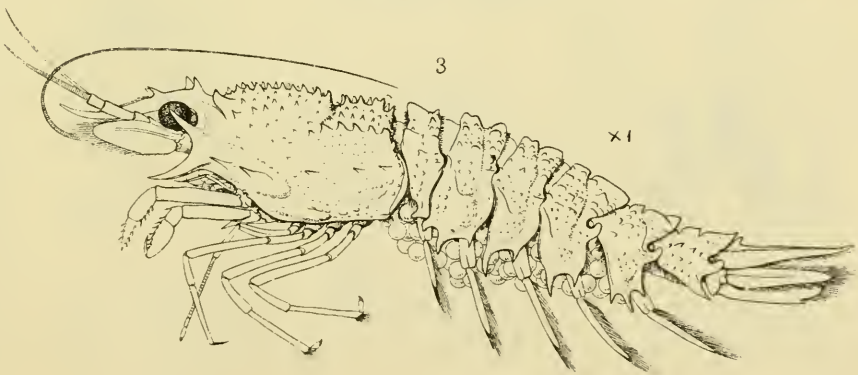
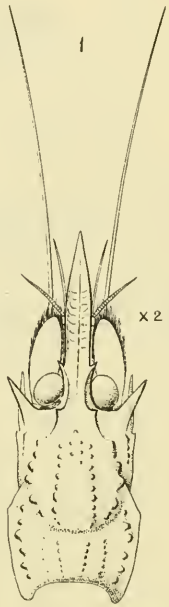
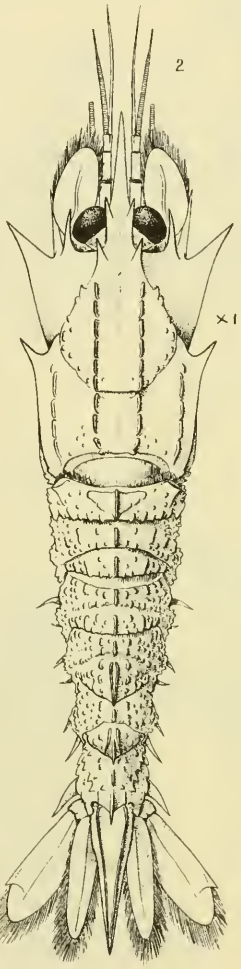
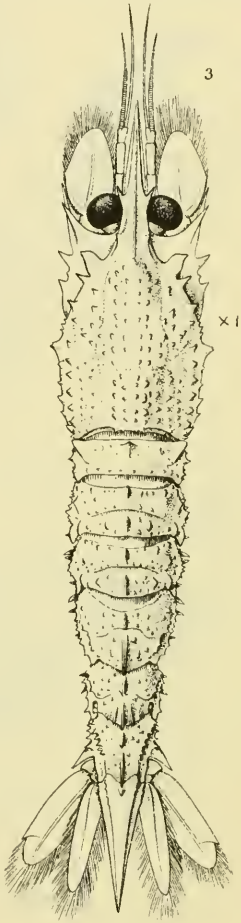


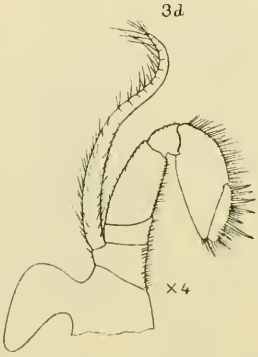
Photo-Lith. E. P. Moore & Son, New Haven, Ct.

RHACHOCARIS LONGIROSTRA, AGASSIZII AND SCULPTA.









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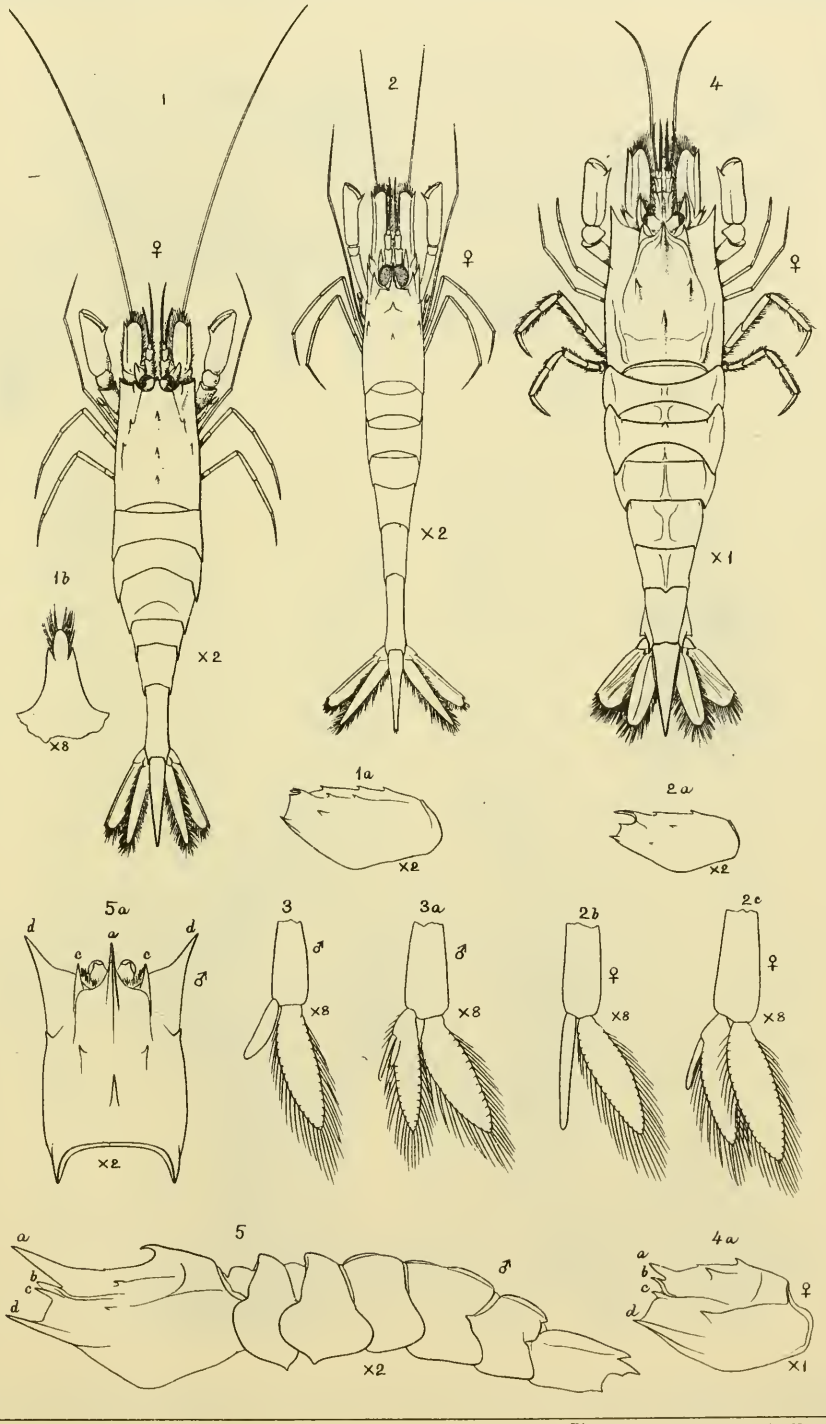
RHACHOCARIS LONGIROSTRA, AGASSIZII AND SCULPTA



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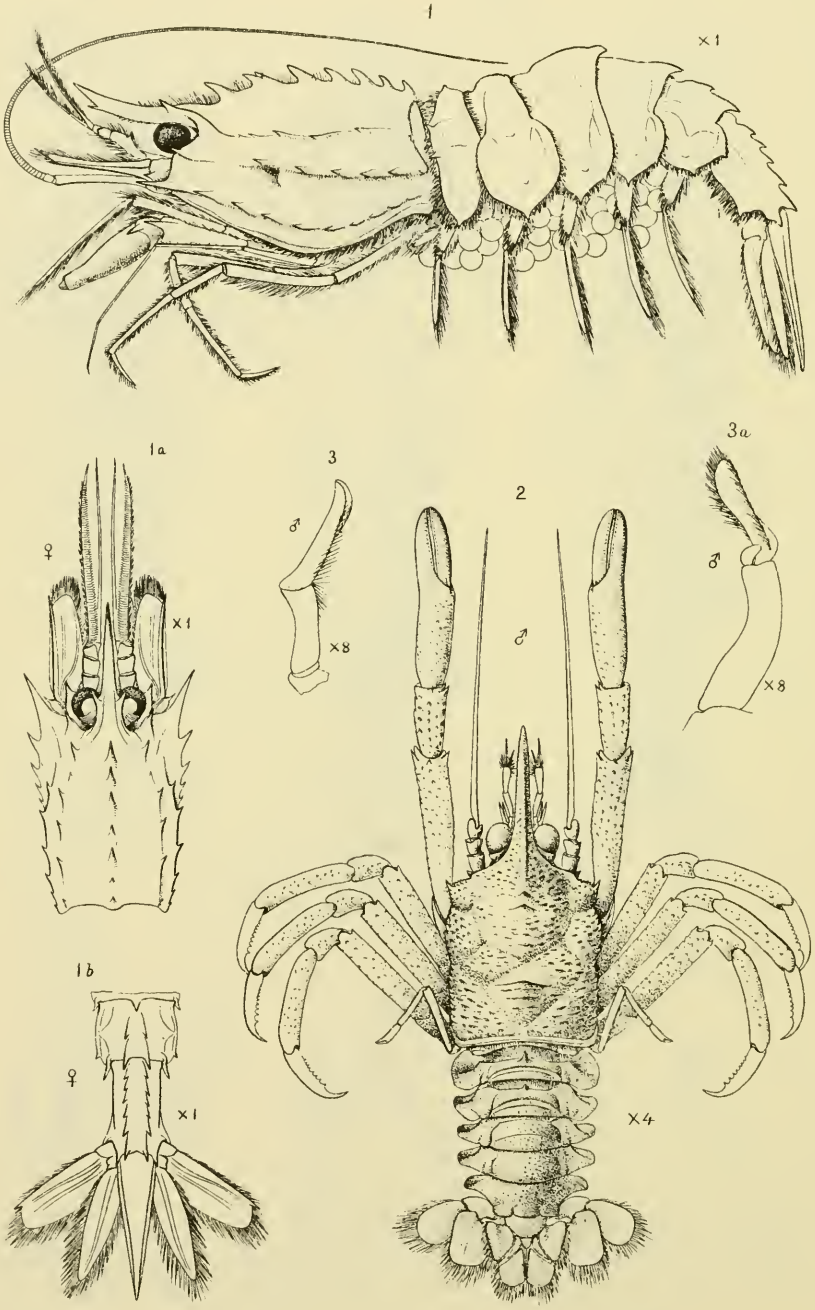
PONTOPHILUS BREVIROSTRIS. P. GRACILIS. CERAPHILUS AGASSIZII.



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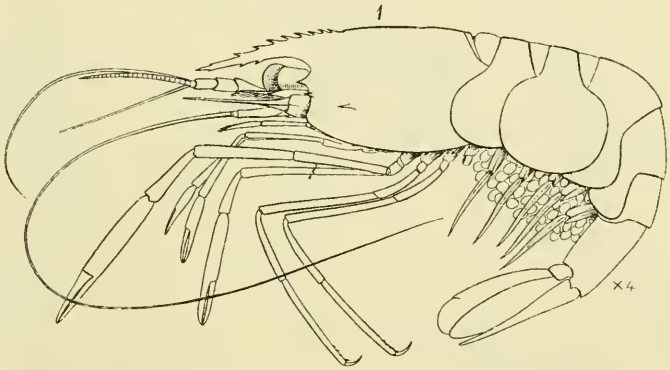
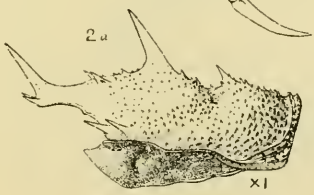
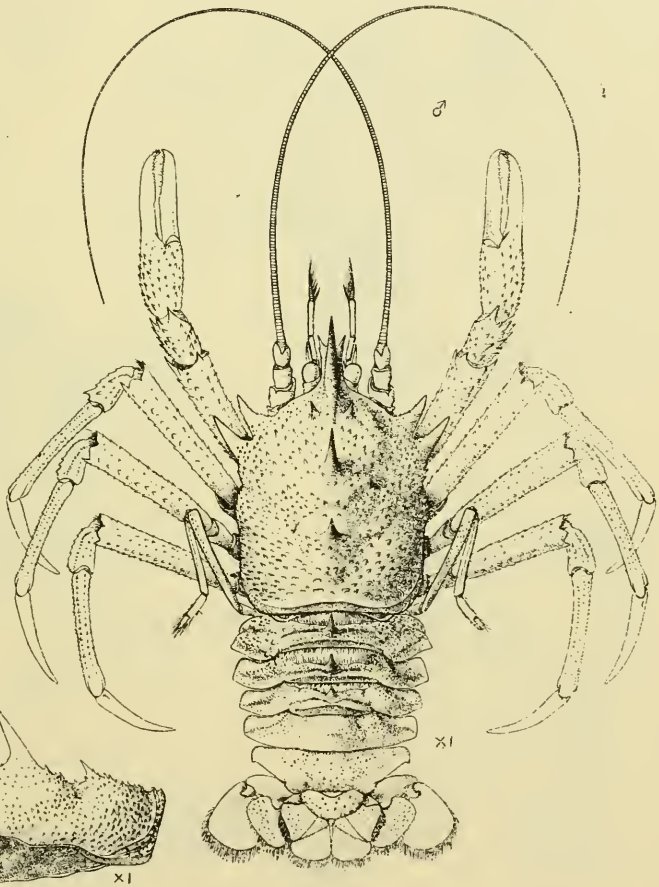
SABINEA PRINCEPS. MUNIDOPSIS CURVIROSTRA.







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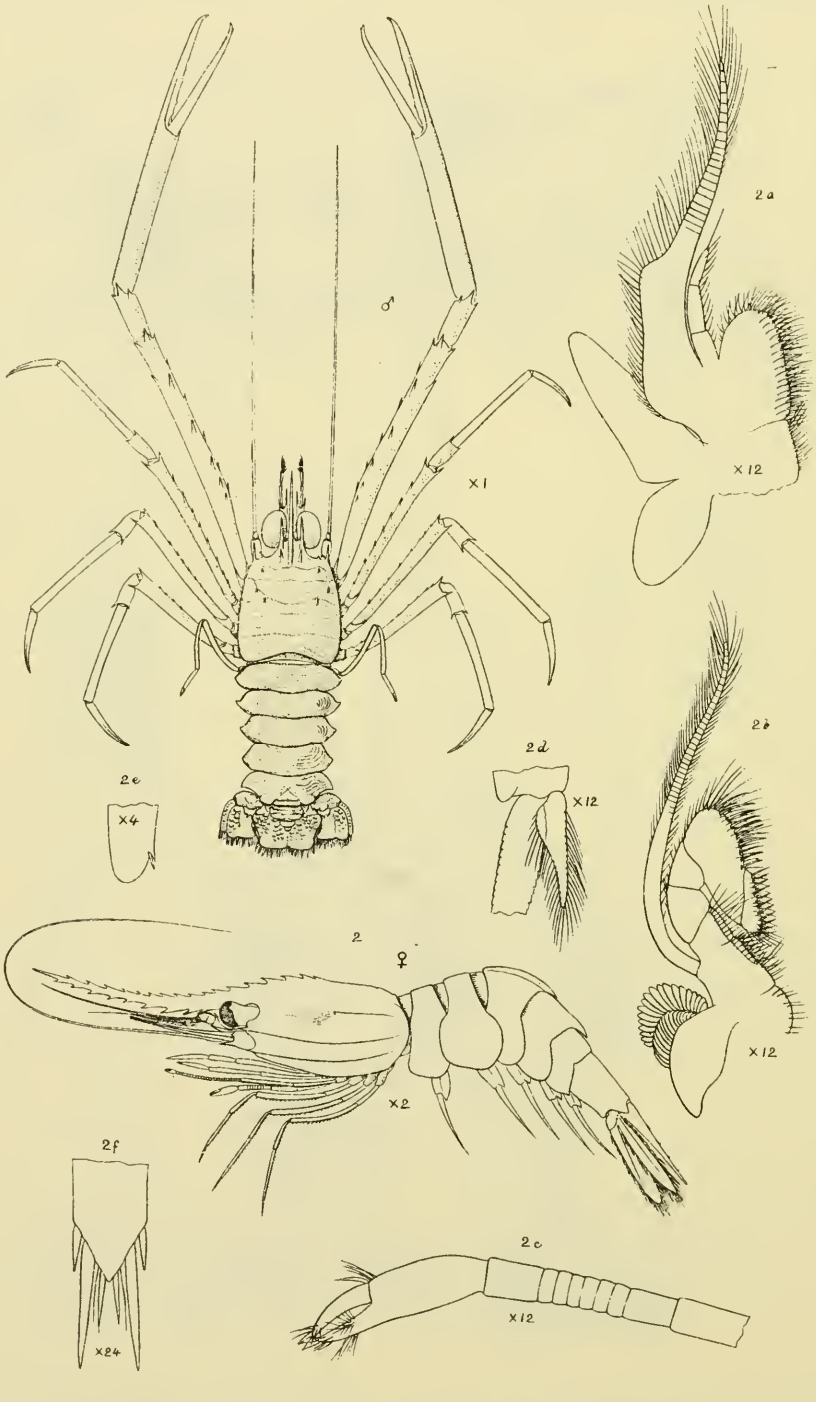
ANCHISTIA TENELLA. GALACANTHA ROSTRATA



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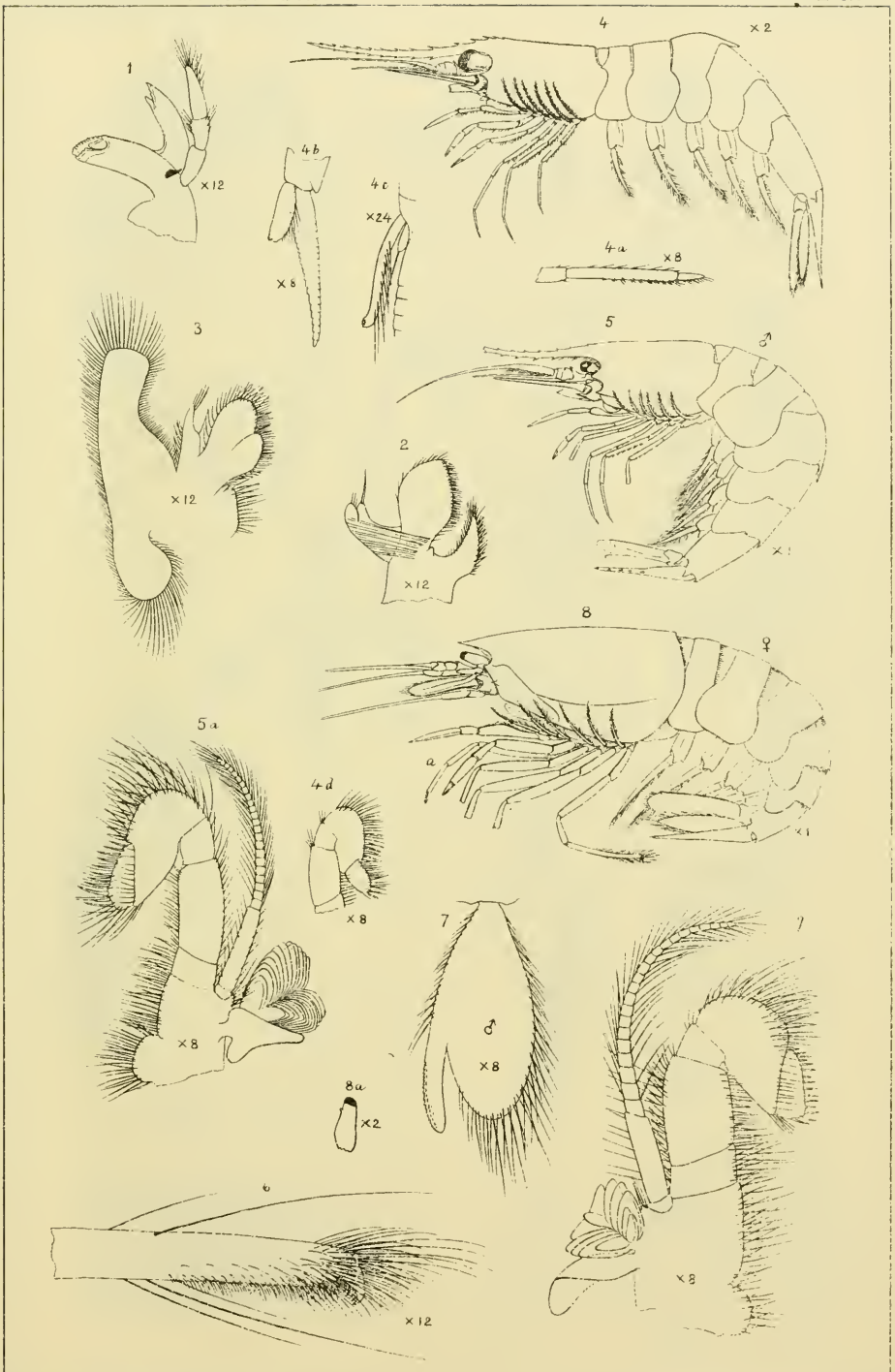
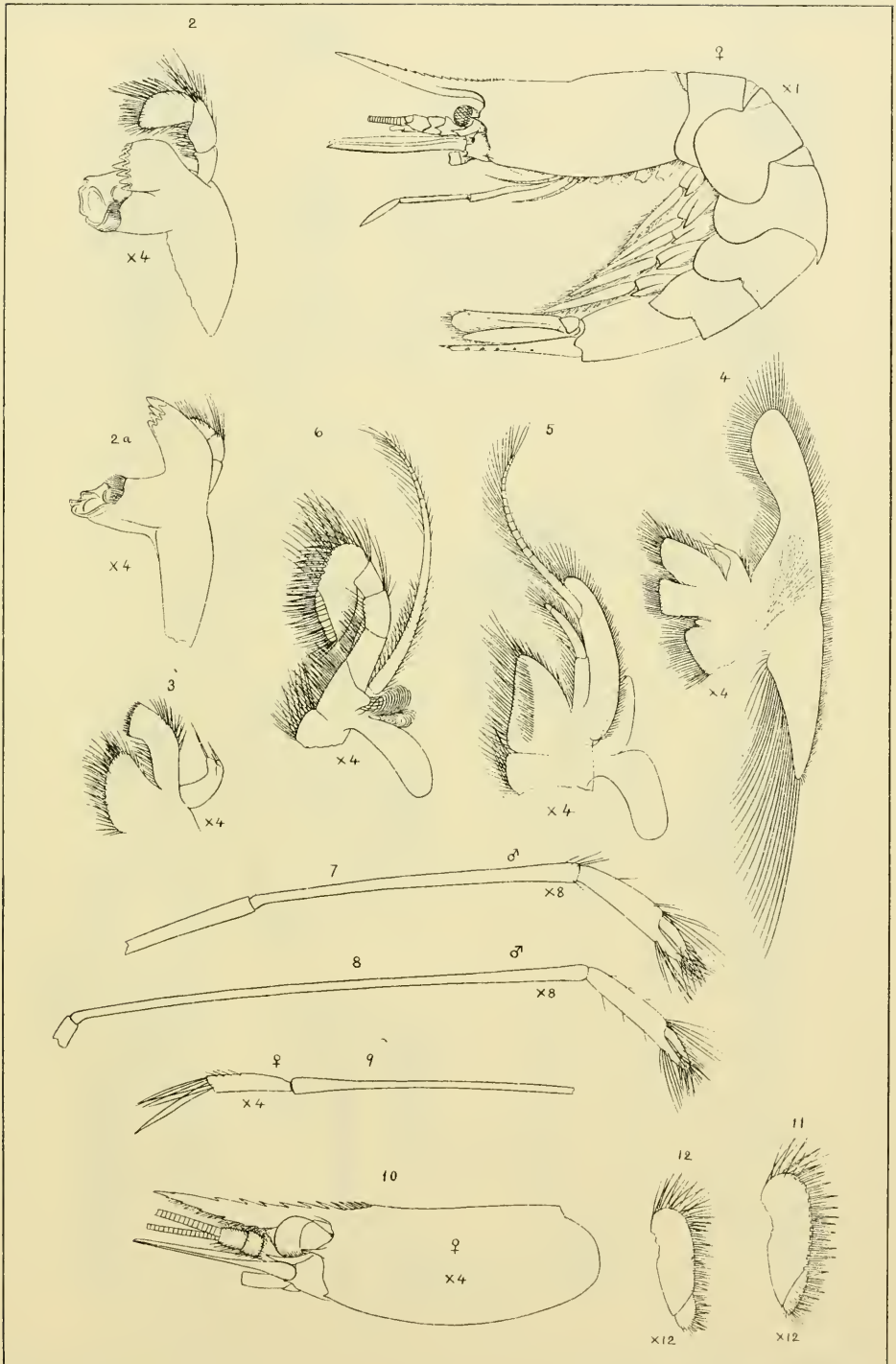
MUNIDA SPECIES. PANDALUS CARINATUS.



Emeric and Smith, del. et lith.

PANDALUS, MIERCIA, MENINGODORA.

MIERSIA AGASSIZII. MENINGODORA MOLLIS.



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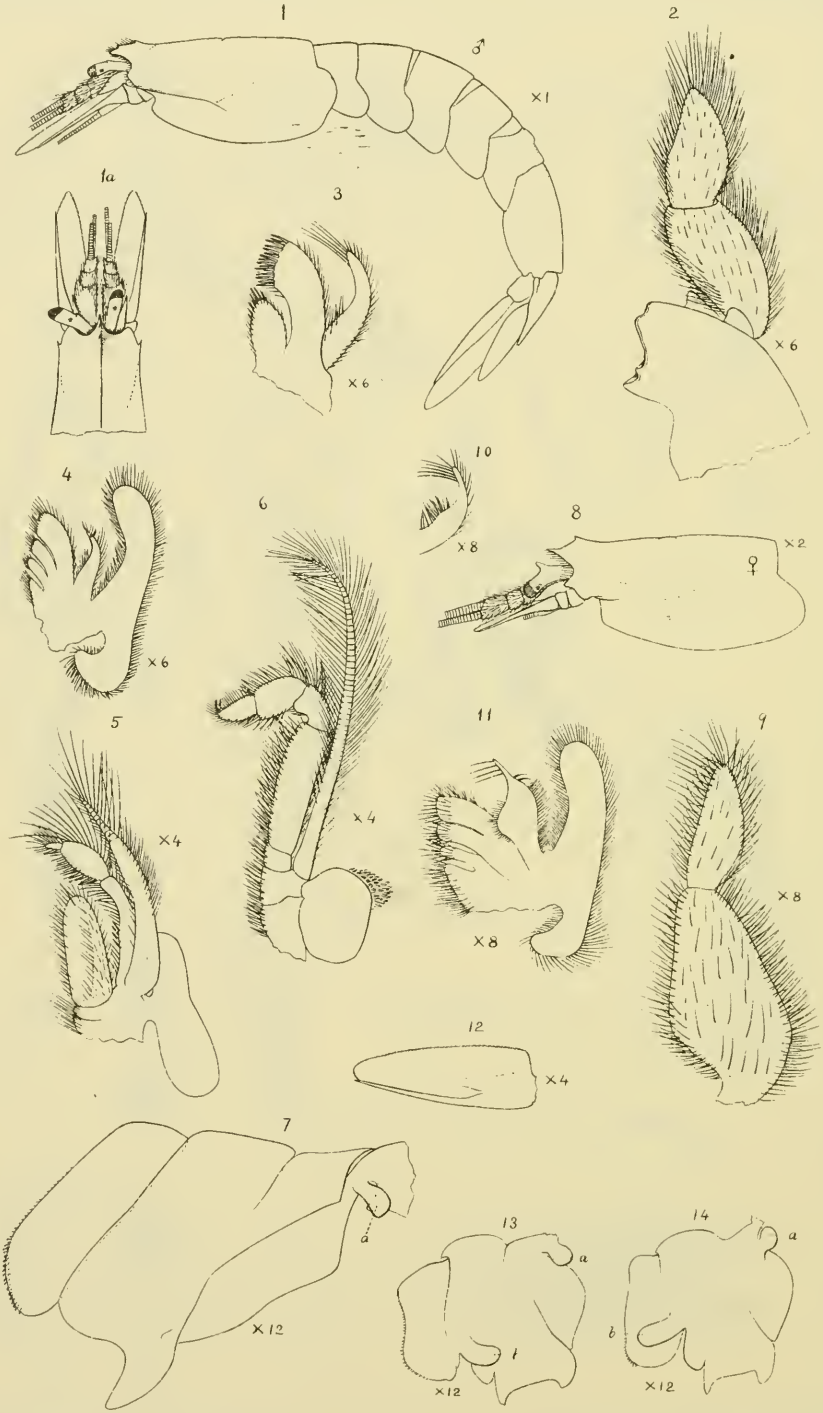
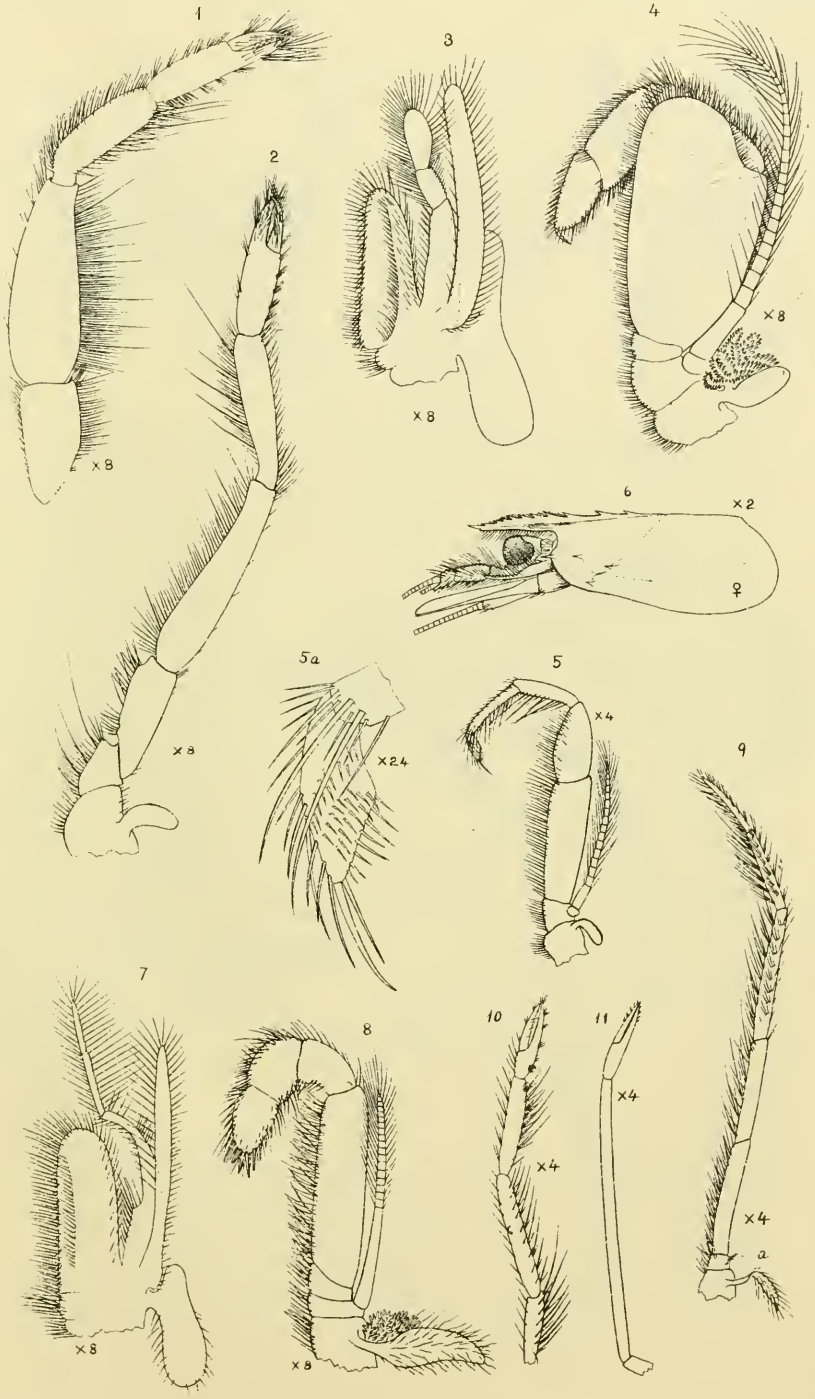
EUMIERSIA ENSIFERA. PANDALUS ACANTHONOTUS.



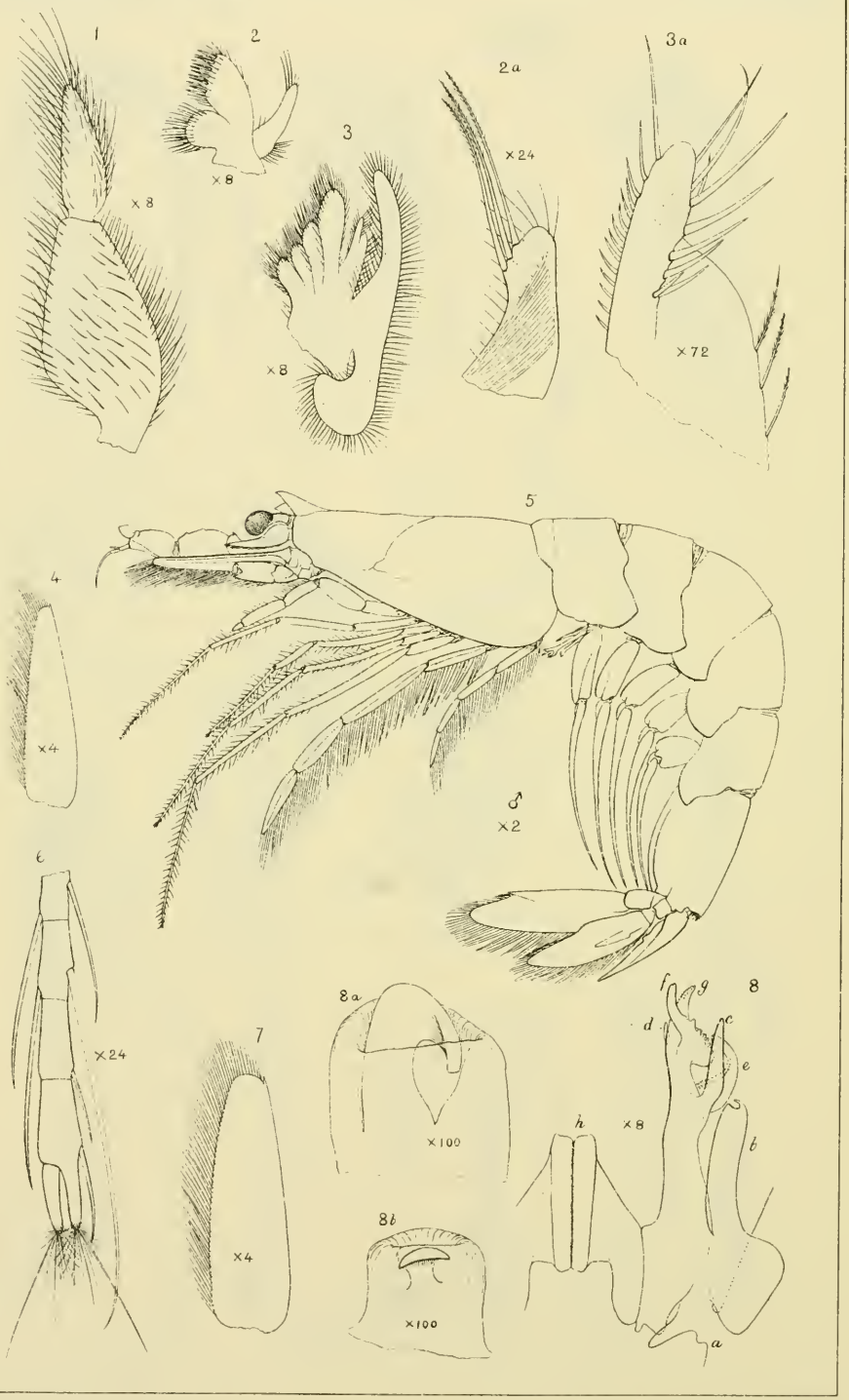
S. I. Smith, from nature. Photo Lith. E. Nicholson, New Haven, Ct.

BENTHESICYMUS BARTLETTI. AMALOPENÆUS ELEGANS.



S. I. Smith, from nature. Photo. Litho E. Grisard, New Haven, Ct.

AMALOPENÆUS ELEGANS. HYMENOPENÆUS DEBILIS.



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HYMENOPENÆUS DEBILIS. SERGESTES ROBUSTUS.

No. 2. — *Bibliography to accompany "Selections from Embryological Monographs" compiled by* ALEXANDER AGASSIZ, WALTER FAXON, *and* E. L. MARK.

II. †

ECHINODERMATA.

BY ALEXANDER AGASSIZ.

It will greatly facilitate the study of the history of the development of Echinoderms by recalling here that in 1836, Thompson (J. V.) first called attention to the remarkable development of Comatula; that next came in 1844 the observations of Sars (M.) on the direct development of Echinaster, and in 1846 of Asteracanthion. This was followed in 1848 by the confirmation of these observations by Desor and Agassiz (L.) In 1847 Dufossé traced many of the stages of development of *Echinus esculentus*. From 1846 to 1855 Johannes Müller published his memoirs on the development of the different orders of Echinoderms. They have formed the basis of all the subsequent publications on the same subject. The more important of these in their chronological order are those of Allman, Carpenter, Thomson (C. W.), and Goette on the Embryology of the Comatulæ; of Krohn, Agassiz (A.), and Metschnikoff on the Embryology of the Sea-urchins; of Koren and Danielssen, Baur, Metschnikoff, and Selenka on the Holothurians; of Schultze, Agassiz (A.), Metschnikoff, and Apostolides on the Ophiurans; and of Van Beneden, Agassiz (A.), and Metschnikoff on the Starfishes. While the memoirs of Müller, Agassiz (A.), Metschnikoff, and others treated of Tornaria as a Starfish larva, the subsequent publications of Metschnikoff and of Agassiz (A.) proved that Tornaria was the larva of Balanoglossus. The literature of this part of the subject is, therefore, repeated here; it will also appear in that of the Vermes, to accompany the illustrations of Balanoglossus. It is taken for granted that no special record is necessary of the older Jahresberichte of Leuckart, of Keferstein, of the Zoölogical Record, and of the recent Berichte of Hoffmann and Schwalbe and of Carus; and that such observations as are found in the notices and reviews of special memoirs must be sought for in the chapters on Echinodermata of these volumes. [*] before a title denotes that I have not seen the work.

CAMBRIDGE, July 1, 1882.

Agassiz, Alexander.

On the Embryology of *Asteracanthion berylinus* Ag. and a Species allied to *A. rubens* M. T. *Asteracanthion pallidus* Ag. *Proc. Amer. Acad. Arts & Sci.*, VI. pp. 106–114. 18 figs. *1863.*

Also separate. *1863.* 8 pp.

† I. Crustacea, by Walter Faxon. See *Bull. Mus. Comp. Zöol.*, IX. No. 6, p. 197, March, 1882.

Agassiz, Alexander (*continued*).

Embryology of the Starfish. Published in December, 1864, advance Pt. I., Vol. V. *Contrib. Nat. Hist. of U. S. of* L. Agassiz. 63 + 7 pp., 8 pl.

(Development of *Asteracanthion berylinus* and *A. pallidus.*)

See also Pt. I. *Mem. Museum Comp. Zoölogy at Harvard College,* V. No. 1, 1877, where the same is found.

Abstr. of this Memoir by A. Agassiz in *Ann. Sci. Nat.*, 1865, III. pp. 367–377.

Embryology of Echinoderms. *Mem. Amer. Acad. Arts & Sci.*, IX. pp. 1–30. *1864.* 38 cuts.

(Development of *Toxopneustes Dröbachiensis, Ophiopholis bellis, Amphiura squamata, Cuvieria Fabricii.*)

Notes on the Embryology of Starfishes (Tornaria). *Ann. Lyceum Nat. Hist.*, VIII. pp. 240–246, Pl. II. New York, *1866.*

Preliminary Report; Echini, and Starfishes, dredged in Deep Water between Cuba and Florida Reef. *Bull. Mus. Comp. Zoöl.* I., No. 9, pp. 253–308. *1869.* Also abstr. transl. by Troschel, *Arch. f. Naturg.*, I. 1870, pp. 127-149.

(On the young stages of Echini, II. p. 279.)

Note on Lovén's article on *Leskia mirabilis* Gray. *Ann. Lyceum Nat. Hist.*, IX. pp. 242–245. New York, *1869.* See also Lovén's and Lütken's articles on *Leskia.*

Revision of the Echini. *Illust. Cat. Mus. Comp. Zoöl., Harvard College,* No. 7. Cambridge (U. S.), *1872–74.* xii + 762 pp., 94 pl., 69 cuts.

Reviewed by P. De Loriol. *Arch. Sci. Phys. et Nat.*, L. pp. 401–411. *1874.* Also reviewed by Edmond Perrier in *Revue des Cours Scientifiques for* 1874

(Part IV. Structure and Embryology of the Echini. 69 cuts. Also young stages in Parts II. and III. *passim.*)

The History of Balanoglossus and Tornaria. (Separate in 1872.) *Mem. Amer. Acad. Arts & Sci.*, IX. pp. 421–436, Pl. I.–IV. *1873.*

Zoölogical Results of the "Hassler" Expedition. I. Echini, Crinoids, and Corals, by Alexander Agassiz and L. F. De Pourtalès. *Illust. Cat. Mus. Comp. Zoöl.*, No. 8. Echini, by A. Agassiz. 1-23 pp., 4 pl. Cambridge, Feb. *1874.*

(Young *Cœlopleurus*, young *Hemiaster Philippii.*)

Embryology of the Ctenophoræ. *Mem. Amer. Acad.*, X. pp. 357–398. 5 pl. *1874.*

(See systematic position and affinities of Echinoderms and Ctenophoræ, pp. 379, and following.)

Agassiz, Alexander (*continued*).

Sur la Fertilisation artificielle de deux Espèces d'Étoiles de Mer. *Arch. Zoöl. Expér. et Génér.*, III. p. xlvi. *1874.*

(*Asteracanthion pallidus* and *A. berylinus.*)

On Viviparous Echini from the Kerguelen Islands. *Proc. Amer. Acad. Arts & Sci.*, XIII. pp. 231–236, 6 cuts. *1876.* Also *Journ. de Zool.*, V. pp. 277–278. *1876.*

(Young *Hemiaster.*)

North American Starfishes. *Mem. Museum Comp. Zoölogy at Harvard College*, V. No. 1. *1877.* iv + 136 pp. 20 pl.

(Part I. pp. 3–83, Pl. I.–VIII. See above, Embryology of the Starfish, orig. pub. in 1864.)

Palæontological and Embryological Development. *Proc. Amer. Assoc. Adv. Sci. Boston*, XXIX. pp. 389–414. *1880.* Also *Ann. Mag. Nat. Hist.* [5], VI. pp. 348–372. *1880.*

Also Transl. by P. De Loriol. Étude sur le Développement Paléontologique et Embryologique. *Arch. Sci. Phys. et Nat.*, V. pp. 516–558. *1881.*

Also same, Die paläontologische Entwickelung der See-Igel im Vergleich zu ihrer individuellen Entwickelung, abstract transl. by E. Krause. *Kosmos*, X. pp. 214–217. *1881.*

Also *Nature*, XXII. No. 566, pp. 424-431, Sept. 2, 1880, and *Amer. Journ. Sci. & Arts* [3], XX. pp. 294-302, 375-389. *1880.*

Report on the Echinoidea, dredged by H. M. S. "Challenger," during 1873–76. London, *1881.* 321 pp., 64 pl. *Rep. Voy. "Challenger," Zoöl.*, III. Pt. IX.

(Young stages of Echini, *passim*; *Cidaris*, *Cœlopleurus*, *Echinothuriæ*, *Palæotropus*, *Spatagocystis*, *Cystechinus*, *Urechinus*, *Pourtalesia*, *Aërope*, *Brissus*; *viviparous Goniocidaris* and *Hemiaster.*)

Agassiz, Alexander and Elizabeth C.

Seaside Studies in Natural History. Marine Animals of Massachusetts Bay. Radiates. Boston, *1865* and *1871.* 153 pp., 185 figs.

(Chapter on Embryology of Echinoderms, p. 143.)

Agassiz, Alexander. *See* (p. 130) **Pourtalès, L. F. de.**

Drawing of Young Holopus from Bahia Honda, Cuba, by A. Agassiz. Pl. II. *Bull. Mus. Comp. Zoöl.*, V. p. 213. *1878–79.*

Agassiz, Louis.

Observations on the Growth and Bilateral Symmetry of Echinodermata. *Philos. Mag.* [3], V. pp. 369–373. *1834.*

Observations sur les Progrès récens de l'Histoire Naturelle des Échinodermes. 21 pp. In Monographies d'Échinodermes. 2de Livraison. Neufchâtel, *1841.* Also *Ann. Mag. Nat. Hist.*, IX. pp. 189–197, 296–302. *1842.*

(Notice of Embryological works, p. 12.)

Agassiz, Louis (*continued*).

Twelve Lectures on Comparative Embryology, delivered before the Lowell Institute in Boston, December and January, 1848–49. Boston, *1849*. 104 pp. (Originally published in the *Boston Traveller*.)

Lectures II. and III. On Development of Echinoderms; p. 12. *Traveller*, of Dec. 22, 1848.

Die Entwickelung eines Seesternes, Echinaster. (From *Daily Evening Traveller*, Boston, Dec. 22, 1848.) *Archiv f. Anat. Phys. und Wiss. Med. 1851*. pp. 122–124.

(See also (p. 116) Desor.)

Allman, George James.

On a Pre-Brachial Stage in the Development of Comatula, and its importance in relation to certain Aberrant Forms of Extinct Crinoids. (Read Feb. 16, 1863.) *Trans. Roy. Soc. Edinburgh*, XXIII. pp. 241–252, Pl. XIII. *1864*.

Anderson, John.

On an apparently New Form of Holothuria. *Ann. Mag. Nat. Hist.*, March, 1862, IX. pp. 189–191, Pl. XI.

(Young *Holothuria*.)

Ankum, H. J. van.

Mededeelingen omtrent de Vergroeiing van de Generatie-organen bij Echinus en eenige verwante Geslachten. *Tijdschr. Nederl. Dierk. Vereen.*, I. pp. 176–187, Pl. IX. *1874*.

Abstr.: *Niederl. Arch. Zool.*, III., Pt. III. p. 279. *1877*.

Sur la Soudure des Organes Génitaux des Oursins Réguliers. *Arch. Néerl.*, XI. pp. 97–116, Pl. IX., X. *1876*.

Apostolides, Nicolas Christo.

1e Thèse. Anatomie et Développement des Ophiures. *Archives de Zool. Expér. et Génér.*, X., Pl. VII.–XII. *1881*.

(Thèses présentées à la Faculté des Sciences de Paris, 1881. Paris, No. d'Ordre 471. 104 pp., 6 pl.)

Baer, K. E. v.

Neue Untersuchungen ueber die Entwickelung der Thiere. *Froriep's Neue Notizen*, XXXIX. p. 38.

(Ei des Seeigel.)

Bull. Physic-Math. Acad. de St. Pétersbourg, V. p. 234.

(Pluteus of Echini.)

Balfour, Francis M.

A Treatise on Comparative Embryology. Vol. I. xi + 492 + xxii. pp., 275 figs. London, *1880*. Vol. II. xi. + 655 + xxii. pp., 429 cuts. London, *1881*.

(Chapter XX., p. 453. Echinodermata.)

Balfour, Francis M. (*continued*).

Also German transl. by Dr. B. Vetter: Handbuch der vergleichenden Embryologie. I. Jena, *1880.*

Essays on Embryology.

I. On the Structure and Homologies of the Germinal Layers of the Embryo. *Quart. Journ. Micr. Sci.*, XX. pp. 247–273, 17 cuts. *1880.*

II. Larval Forms: their Nature, Origin, and Affinities. *Quart. Journ. Micr. Sci.*, XX. pp. 381–407. 21 cuts. *1880.*

Bastian, H. Charlton.

On the Anatomy and Physiology of the Nematoids, Parasitic and Free; with Observations on their Zoölogical Position and Affinities to the Echinoderms. *Phil. Trans. Roy. Soc. London*, CLVI. pp. 545–638, Pl. XXII.–XXVIII. *1866.*

Barrois, J.

Embryogénie de l'*Asteriscus verruculatus*. *Journ. de l'Anat. et de la Physiol.*, XV. pp. 1–8, Pl. I., II. *1879.*

Baur, Albert.

Beiträge zur Naturgeschichte d. *Synapta digitata*. Drei Abhandlungen. Dresden, *1864.* 51; 60; 119 pp., 8 pl.

(Zweite Abhandlung, Metamorphose und Entwickelung der *Synapta digitata*.)

Bell, F. Jeffrey.

Note on the Number of Anal Plates in Echinocidaris. *Proc. Zöol. Soc. London*, pp. 436, 437. *1879.*

Exhibition of an Immature Echinoid. *Proc. Zöol. Soc. London*, pp. 356–358. *1880.*

(Palæolampas, the immature form of an Echinolampas.)

Observations on the Characters of the Echinoidea. Part III. On Some Genera and Species of the Temnopleuridæ. *Proc. Zöol. Soc. London*, June 1, 1880. pp. 422–440, Pl. XLI.

(Describes the young forms of several species.)

On the Apparent Retention of a Sur-Anal Plate by a Young Echinometra. *Journ. Linn. Soc. London*, Zoöl., XV. pp. 318–320. *1881.*

Abstr. *Journ. Roy. Mic. Soc.* [2], I. p. 896. *1881.* Also *Zool. Anzeig.*, No. 99, p. 896.

See also p. 119, Gegenbaur, Carl.

Beneden, P. J. van.

Sur deux Larves d'Échinodermes de la Côte d'Ostende. *Bull. Acad. Roy. Belgique*, XVII. pp. 508–515, 1 pl. *1850.* *L'Institut Journ. Gén. Soc. Trav. Sci.*, XVIII, p. 276. *1850.*

(*Bipinnaria* and Ophiuran larvæ.)

Beneden, P. J. Van (*continued*).

Ueber Zwei Larven von Echinodermen. *Froriep's Tagsb. Fortschr. Nat. u. Heilk.*, I. p. 257. *1850.* Same as above.

Bergh, R. S.

Bidrag til Opfattelsen af Kløvning og Kimbladdannelse hos Echiniderne. *1879. Vidensk. Meddel. naturh. Foren. Kjobenhavn*, pp. 255–264. *1879–80.*

(p. 7, fig. of Gastrula of *Psammechinus miliaris.*)

Billings, E.

Note on *Leskia mirabilis* Gray, by S. Lovén, communicated by C. F. Lütken. *Can. Nat. Geol.* (N. S.), III. pp. 442–445. 5 figs. *1868.*

(For reply, see p. 125, Lütken, "Hyponome Sarsi."

Note on Hyponome Sarsi, described by S. Lovén, by C. F. Lütken. *Can. Nat. Geol.* (N. S.), IV. p. 270. *1869.*

Notes on the Structure of the Crinoidea, Cystidea, and Blastoidea. *Amer. Journ. Sci.* [2], XLVII. p. 353, XLVIII. pp. 69–83, XLIX. pp. 51–58, L. pp. 225–240. *1869–70. Ann. Mag. Nat. Hist.* [4], V. pp. 251–266, 409–416; [4], VII. pp. 142–158. *1870–71. Can. Nat. Geol.* [2], IV. pp. 277–293, 426–433; [2], V. pp. 180–198. *1869–70.*

(Refers to young stages of Echinoderms for comparisons.)

Bronn, H. G.

Klassen und Ordnungen des Thier-Reichs, Strahlenthiere, II. *(Actinozoa.)* Leipzig u. Heidelberg, *1860.* 434 pp., 49 pl. and cuts.

(Chapters on the development of the different orders of Echinoderms.)

Brooks, W. K.

Handbook of Invertebrate Zoölogy for Laboratories and Seaside Work. Boston, *1882.* viii. + 392 pp., 202 figs.

XIV. pp. 99–139. The Embryology and Metamorphosis of Echinoderms. — Figs. 43–77. development of Arbacia, by W. K. Brooks, H. Garman, and B. P. Colton. — Figs 78–83. Brachiolaria and Young Starfish by E. B. Wilson.

Busch, Wilhelm.

Beobachtungen ueber Anatomie und Entwickelung einiger Wirbellosen Seethiere. 143 pp., 17 pl. Berlin, *1851.*

p. 76. Echinodermen Entwickelung.

(Stages of Echinaster, Asteracanthion, Comatula, Echinocidaris, Pl. XII., XIII. XIV.)

Carpenter, P. Herbert.

On Some Points in the Anatomy of *Pentacrinus* and *Rhizocrinus. 1877. Journ. Anat. & Physiol.*, XII. pp. 35–53. *1878.*

Carpenter, P. Herbert (*continued*).

On the Apical and Oral Systems of the Echinodermata, Pt. I. *Quart. Journ. Micr. Sci.*, XVIII. pp. 351–383; Pt. II. (same), XIX. pp. 176–206, cuts. *1878, 1879.*

(Embryonic stages fully discussed.)

Some Disputed Points in Echinoderm Morphology. *Quart. Journ. Micr. Sci.*, XX. pp. 322–330. *1880.*

(Homologies of embryonic stages, *passim.*)

Feather Stars, Recent and Fossil. *Pop. Sci. Rev.* (N. S.), IV. Pl. V., VI. pp. 193–214. *1880.*

(Account of development of Antedon, after CARPENTER, THOMSON, and others. Cuts.)

Carpenter, William B.

Researches on the Structure, Physiology, and Development of *Antedon* (*Comatula* Lam.) *rosaceus*. *Ann. Mag. Nat. Hist.* [3], XVI. pp. 200–202. *1865.* Abstr. *Proc. Roy. Soc. London*, XIV. pp. 376–378. *1865.*

Researches on the Structure, Physiology, and Development of *Antedon* (*Comatula* Lk.) *rosaceus*. Pt. I. *Philos. Trans. Roy. Soc. London*, CLVI. (1866), pp. 671–756, Pl. XXXI.–XLIII.

(Development of the skeleton, p. 726, Pl. XXXIX.–XLII.)

On the Structure, Physiology, and Development of *Antedon* (*Comatula* Lamk.) *rosaceus*. *Proc. Roy. Soc. London*, No. 166, *1876*, pl. 8, 9, pp. 211–231.

Supplement to above, No. 169, *Proc. Roy. Soc. London*, XXIV. pp. 451–455. *1876.*

Carus, J. Victor.

Icones Zootomicæ. Erste Haelfte. Die wirbellossen Thiere. Leipzig, *1857.* 23 pl.

Echinodermata I., Pl. V. fig. 14.

(Young Comatula, after THOMPSON.)

Zoologischer Jahresbericht für 1879, 1880. Herausgegeben von der Zoologischen Station zu Neapel.

(Echinodermata, by Dr. HUB. LUDWIG.)

Claparède, A. René Edouard.

Beobachtungen ueber Anatomie und Entwickelungsgeschichte Wirbelloser Thiere an der Küste von Normandie angestellt. Leipzig, *1863* viii + 120 pp., 18 pl.

(Ueber eine neue Echinodermen Larve, p. 7, Pl. I., figs. 11, 12.)

Claus, Carl.

Grundzüge der Zoologie. Dritte Auflage. Marburg u. Leipzig, *1876.* xii + 1254 pp.

(Echinodermata: Metamorphose, pp. 265–277.)

Claus, Carl (*continued*).

Grundzuge der Zoologie. 4e Auflage. I. Pt. 2. Echinodermata, pp. 305–374. Marburg, *1879*.

Colton, B. P. *See* (p. 118) **Garman, H.**, *and* **Colton, B. P.**, *also* (p. 114) **Brooks, W. K.**

Dalyell, Sir John G.

Report Brit. Ass., 1840. *Froriep's Notizen*, XVI. No. 331, pp. 1–5. *1840*.
(Young Holothuriæ.)

Powers of the Creator. I. pp. 91–100. London, *1851*.

Danielssen, D. C. *See* (p. 121) **Koren** and **Danielssen**, and (p. 131) **Sars, Koren,** and **Danielssen.**

Dareste, C.

Analyse des Observations de J. Müller sur le Développement des Échinodermes. I. Du Développement des Échinides. *Ann. Sci. Nat.* [3], XVII. pp. 349–376, Pl. XIII. *1852*.

Analyse des Observations de J. Müller sur le Développement des Échinodermes. II. Développement des Astéries. *Ann. Sci. Nat.* [3], XIX. pp. 244–282, Pl. VIII. *1853*.

Analyse des Observations de J. Müller sur le Développement des Ophiures. III. Développement des Ophiures. *Ann. Sci. Nat.* [3], XX. pp. 121–150, Pl. IV. *1853*.

Analyse des Observations de J. Müller sur le Développement des Échinodermes. IV. Du Développement des Holothuries. *Ann. Sci. Nat.* [3], XX. pp. 247–280, Pl. XVI. *1853*.

Mémoire sur le Plan Général du Développement des Échinodermes, par J. Müller. *Ann. Sci. Nat.* [4], I. pp. 153–175, 1 pl. *1854*.

Delle Chiaje, Stephano.

Memoria su la Storia e Notomia degli Animali senza Vertebre del Regno di Napoli. Napoli, *1823–29*.
(Young Holothuria, Pl. CXVI., figs. 16–18.)

Derbès, Alph.

Observations sur le Mécanisme et les Phenomenes qui accompagnent la Formation de l'Embryon chez l'Oursin Comestible. *Ann. Sci. Nat.* [3], VIII. pp. 80–98, Pl. V. *1847*.

Desor, E.

[On the Development of the Embryo of the Starfish.] *Proc. Boston Soc. Nat. Hist.*, III. p. 14. *1848–51*.

Ueber die Entwickelung der Asterien. *Arch. f. Anat. Physiol. u. Wiss. Med.*, pp. 79–83, Pl. II. figs. 1–12. *1849*.
(Echinaster.)

Dönitz, W.

Ueber den typischen Bau der Echinodermen. *Arch. f. Anat. Physiol. u. Wiss. Med.*, pp. 406–413, Pl. XI. B. *1866.*

Düben, M. W., and Koren, J.

Zoologiske Bidrag — Om Holothuriernas Hudskelett. *Kongl. Vetensk. Akad. Handl. for* 1844, pp. 211–328, Pl. IV–XI. Stockholm, *1846.*

(Figure young Holothuriæ on Pl. XI.)

Dufossé, le Dr.

Observations sur le Développement des Oursins. C. R., *Acad. Sci., Paris,* 1847, p. 15. *Ann. Sci. Nat.* [3], VII. pp. 44–52. *1847.*

(*Echinus esculentus.*)

Nouvelle Note sur le Développement des Oursins. *Comptes Rendus, Acad. Sci., Paris,* XXV. p. 311. *1847. L'Institut,* No. 712, p. 175. *1847.*

Dujardin, F., et Hupé, H.

Histoire Naturelle des Zoophytes Échinodermes. [Suites à Buffon.] Paris, *1862.* 625 pp. 10 pl.

(See general chapters on the different orders; Pl. I. and Pl. VI. contain original figures on the development of Comatula, also other Echinoderm larvæ copied from Thompson and Muller.)

Edwards, Henri Milne.

Observations sur les Sexes des Oursins. *Comptes Rendus, Acad. Sci., Paris,* X. p. 780. *1840.*

Leçons sur la Physiologie et l'Anatomie Comparée de l'Homme et des Animaux. Échinodermes, VIII. pp. 304–320. Paris, *1863.* — Reproduction des Zoophytes, IX. p. 395. *1870.*

Fol, Hermann.

Sur les Phénomènes Intimes de la Fécondation. *Comptes Rendus, Acad. Sci., Paris,* LXXXIV. pp. 268–271. *1877.*

(On the Pronuclei of the Sea-urchin and *Asterias.*)

Sur le Premier Développement d'une Étoile de Mer. *Comptes Rendus, Acad. Sci., Paris,* LXXXIV. pp. 357–360. *1877.*

(On the amphiaster of *Asterias glacialis,* and the disappearance of the germinative vesicle and dot.)

On the First Development of a Starfish. *Ann. Mag. Nat. Hist.* [4], XX. pp. 154–156. *1877.* Transl. from C. R. Feb. 19, 1877, p. 357.

(Amphiaster of *Asterias glacialis.*)

Sur Quelques Fécondations Anormales chez l'Étoile de Mer. *Comptes Rendus, Acad. Sci., Paris,* LXXXIV. pp. 659–661. *1877.*

On Some Abnormal Fecundations in Starfishes. *Ann. Mag. Nat. Hist.* [4], XX. pp. 158–160. *1877.* Transl. from C. R. April 2, 1877, p. 659.

(Phenomena of abnormal segmentation.)

Fol, Hermann (*continued*):

Note sur la Fécondation de l'Étoile de Mer et de l'Oursin. *Comptes Rendus, Acad. Sci., Paris,* LXXXV. pp. 233–236. *1877.*

Encore un Mot sur la Fécondation des Echinodermes. *Comptes Rendus, Acad. Sci., Paris,* LXXXV. pp. 625–628. *1877.*

Sur la Fécondation et le Premier Développement de l'Œuf. *Act Soc. Helvét. Sci. Nat.,* 60e Sess., pp. 165–172. *1877.*

(Oursins, Astéries.)

Réponse à quelques Objections formulées contre mes Idées sur la Pénétration du Zoosperme. *Arch. Zool. Expér. et Génér.,* VI. pp. 180–192. *1877.*

Sur le Commencement de l'Hénogénie chez Divers Animaux. *Archiv. des Sci. Phys. et Nat. de Genève.* Avril 15, *1876. Arch. Zool. Expér.,* VI. pp. 145–169. *1877.* Also *Arch. Sci. Nat.,* LVIII. pp. 439–472; LX. pp. 321–326. *1877.*

Sopra i Fenomeni Intimi della Fecondazione degli Echinodermi. *Trans. R. Acad. Lincei, Rome* [3], I. *1877.*

Recherches sur la Fécondation et le Commencement de l'Hénogénie chez Divers Animaux. *Mém. Soc. Phys. d'Hist. Nat. Genève,* XXVI. pp. 89–397, Pl. I.–VI. *1878–79.*

(*Asterias glacialis, Toxopneustes lividus.*)

Forbes, Edward.

A History of British Starfishes and Other Animals of the Class Echinodermata. xx + 267 pp. Figs. London, *1841.*

(Development of Comatula, p. 11.)

Fewkes, J. W.

On the Development of the Pluteus of Arbacia. *Mem. Peabody Acad. Sci.,* I., No. 6. pp. 1–10, Pl. I. Salem, *1881.*

Galeb, O.

De l'Œuf dans la Sèrie Animale. 106 pp. Paris, *1878.*

(Echinodermes, p. 28.)

Garman H., and Colton, B. P. *See also* (p. 114) Brooks, W. K.

Some Notes on the Development of *Arbacia punctulata* Lam. *Studies Biol. Lab. Johns Hopkins Univ.* II. Pl. XVII., XVIII. pp. 247–255. Baltimore, *1882.*

(Late stages of Pluteus and young Sea-urchin.)

Gegenbaur, Carl. *See also* (p. 122) Krohn.

Strahlthiere p. 329 in Bericht über einige im Herbste 1852 in Messina angestellte vergleichend-anatomische Untersuchungen, von C. Gegenbaur, A. Kölliker, u. H. Müller. *Zeitschr. f. Wiss. Zool.,* IV. pp. 299–370. *1853.*

(III. Strahlthiere: Larvæ of Echinoderms, p. 329.)

Gegenbaur, Carl (*continued*).

Grundzüge der Vergleichenden Anatomie. 2te Auflage. 892 pp., 391 fig. Leipzig, *1870*.

(Vierter Abschnitt. p. 303. Echinodermen, allgemeine Uebersicht.)

(See also English and French translations of the above, by Bell and Schneider.)

Elements of Comparative Anatomy. (Translated by F. Jeffrey Bell; the translation revised, and a Preface written by E. R. Lankester). London, *1878*. xxvi + 645 pp., 356 figs.

(Echinoderma, pp. 192–227, figs. 94–116.)

Giard, A.

Note sur les Premiers Phénomènes du Développement de l'Oursin. *Comptes Rendus, Acad. Sci., Paris*, LXXXIV. pp. 720–722. *1877*. *Ann. Mag. Nat. Hist.* [4], XIX. pp. 434–436. *1877*.

(*Echinus miliaris*.)

Sur la Fécondation des Échinodermes. *Comptes Rendus, Acad. Sci., Paris*, LXXXV. pp. 408–410. Août 13, *1877*.

(On artificial fecundation, normal and pathological segmentation.)

Sur une Fonction Nouvelle des Glandes Génitales des Oursins. *Comptes Rendus, Acad. Sci., Paris*, LXXXV. pp. 858–859. *1877*.

(During a part of the year, the genital organs act also as organs of secretion.)

*Particularités de Reproduction de certains Échinodermes en Rapport avec l'Éthologie de ces Animaux. *Bull. Sci. Nord* [2], 1. pp. 296–304. *1878*.

(*Asterina gibbosa*; hermaphroditisme chez certaines Ophiures. *Teste, Zool.*, Anz. II. No. 18, p. 1. *1879*.)

Goette, Alexander.

Vergleichende Entwicklungsgeschichte der *Comatula mediterranea*. *Arch. Mikr. Anat.*, XII. pp. 583–648, Pl. XXV.–XXVIII. *1876*.

Bemerkungen zur Entwickelungsgeschichte der Echinodermen. *Zool. Anzeig.*, III. pp. 324–326. *1880*.

(*Bipinnaria*, *Auricularia*.)

Gosse, Philip Henry.

Tenby: a Seaside Holiday. London, *1856*. xx + 400 pp., 24 pl.

(Chapter XXX., young Sea-urchins, p. 282; Pl. XVI.-XVIII.; larva of a Spatangoid, Pl. XVI., XVII.; pluteus of *Echinus miliaris*, Pl. XVII.)

Greeff, Richard.

Ueber den Bau der Echinodermen. Erste Mittheil. No 8. November, *1871*. 2te Mittheil. No. 6. July, *1872*. 3te Mittheil. No. 11. December, *1872*. *Sitzungsb. Gesellsch. Beförd. gesammt. Naturw. Marburg*, pp. 1–9, 93–108, 158–172. *1871–72*

Greeff, Richard (*continued*).

Ueber den Bau der Echinodermen. Vierte Mittheilung. *Sitzungsb. der Gesell. Beförd. der gesammt. Naturw. zu Marburg*, Jan. 1876, No. 1, pp. 16–37, cuts.

(III. p. 34. Ueber die Entwickelung des *Asteracanthion rubens* vom Ei bis zur *Bipinnaria* und *Brachiolaria*.)

Ueber den Bau und die Entwickelung der Echinodermen. *Sitzungsb. Gesellsch. Beförd. gesammt. Naturw. Marburg*, pp. 47–54, 83–95, 4 cuts. *1876*.

(5te Mittheil. 1. Parthenogenesis bei den Seesternen. 2. Ueber das Verschwinden des Keimbläschens und Keimflecks im Ei des *Asteracanthion rubens*. 3. Ueber das Herz der Crinoideen; fig. of young Comatula.)

Ueber Echiuren und Echinodermen. *Arch. f. Naturgesch.*, XLVI., I. pp. 88–101. *1880*.

(II. p. 94, Ueber den Bau und die Entwickelung der Echinodermen, sechste Mitth. Entwickelung v. Asterias.)

Grube, E.

Ueber einen lebendig gebärenden Seeigel (*Anochanus sinensis*). *Monatsb. k. Akad. Wissensch. Berlin.*, pp. 178–180. *1868*.

Transl. in *Ann. Mag. Nat. Hist.* [4], II. pp. 168–170. *1868*.

Haeckel, Ernst.

Generelle Morphologie der Organismen. I. xxiv + 574 pp., 2 pl.; II. clx + 462 pp., 8 pl. Berlin, *1866*.

II. Fünftes Buch, Erster Theil d. allgemeinen Entwickelungsgeschichte der Organismen.

Ueber die Individualität des Thierkörpers. *Jenaische Zeitschr. Naturw.*, XII. pp. 1–20. *1878*.

Die Kometenform der Seesterne und der Generationswechsel der Echinodermen. *Zeitschr. f. wissensch. Zool.*, XXX. Suppl., Pl. XX. pp. 424–455. *1878*.

Abstr. *Arch. Zool. Expér. et Génér.*, VI. pp. xxxiii–xxxvii. *1877*. *Kosmos*, III. pp. 358–362. *1878*. *Sitzungsb. Jenaische Gesellsch. Med. Naturw.*, pp. vi., vii. Jena, *1879*.

Biologische Studien. Zweites Heft. Mit 14 Tafeln. Studien zur *Gastræa Theorie*. *Jenaische Zeitschr.*, VIII. pp. 1–55, Pl. I. *1874*. IX. pp. 402–508, Pl. XIX.–XXV. *1875*. (Also separate.) Jena, *1877*. 270 pp.

(Pl. 1 f. 6, Gastrula of Asterias; Pl. II. fig. 33, Starfish Archigastrula.)

Hatschek, B.

Ueber Entwickelungsgeschichte von Teredo. Mesodermbildung bei *Toxopneustes*, p. 30. *Arbeit. Zool. Inst. Univ. Wien*, III. pp. 1–44, 3 pl. *1880*.

Hensen, Victor.

Ueber eine Brachiolaria des Kieler Hafens. *Arch. f. Naturgesch.*, pp. 242–246, Nachtrag, pp. 363, 364. *1863*.

Hertwig, Oscar.

Beiträge zur Kenntniss der Bildung, Befruchtung und Theilung des thierischen Eies. *Morphol. Jahrb.*, I. pp. 347–434, Pl. X.–XIII. *1875.*
Abstr. *Arch. Zool. Expér. et Génér.*, V. pp. xxi–xxvi. *1876.*
(*Toxopneustes lividus.*)

Weitere Beiträge zur Kenntniss der Bildung, Befruchtung und Theilung des thierischen Eies. *Morphol. Jahrb.*, III. pp. 271–279; IV. pp. 156–175, 177–213, Pl. VI.-VIII. *1877, 1878.* Also *Arch. Zool. Expér. et Génér.*, VI. pp. 171–179, *1877*; VII. pp. i–vii. *1878.*
(Eientwickelungen von Asteracanthion.)

Nouvelles Contributions à la Connaissance de la Fécondation et du Fractionnement de l'Œuf des Animaux. Traduit par Hermann Fol. *Archiv. Zool. Expér. et Génér.*, VI. p. 171. *1877.*
(Asteracanthion.)

Hoffmann, Fr., u. Schwalbe, G.

Jahresberichte ueber die Fortschritte der Anatomie u. Physiologie. *1872–1880.*
(Entwickelungsgeschichte.)

Huxley, Thomas H. *See* (p. 128) **Müller, Johannes.**

Report upon the Researches of Müller into the Anatomy and Development of the Echinoderms. *Ann. Mag. Nat. Hist.* [2], VIII. pp. 1–19, 1 pl. *1851.*
See *Medical Times and Gazette for* 1856 and 1857.
A Manual of the Anatomy of Invertebrated Animals, London, *1877*; and a German translation, by Dr. J. W. Spengel.
(Chapter IX. p. 543, "The Echinodermata," treats of the development of each order. No original figs. See also The Elements of Comparative Anatomy, p. 42. London, *1864.*)

Keferstein, W.

Berichte ueber die Fortschritte in der Generationslehre in den Jahren 1858–1867. Aus Henle u. Pfeiffer, *Archiv. f. Rationelle Medicin.*

Kölliker, A. *See* (p. 118) **Gegenbaur.**

Koren, J., and Danielssen, D. C.

Zoologiske Bidrag. Bemaerkninger til *Bipinnaria asterigera. Nyt. Mag. Naturv. Christiania*, V. pp. 253–272. *1848.*

Observations sur la *Bipinnaria asterigera. Ann. Sci. Nat.*, [3], VII. pp. 347–352. Pl. VII. fig. 7–9. *1847.* Also *Isis.* 1848, pp. 205–208. figs.
Transl. from *Nyt. Mag. f. Nat.*, p. 264. Christiania, *1848.*

Observations sur le Développement des Holothuries. In Sars, M., Koren, J., Danielssen, D. C. Fauna Littoralis Norvegiæ. 2de Livraison. 101 pp., 12 pl. Bergen, *1856.*
(pp. 46–54, *Holothuria tremula*, Pl. VII., VIII. figs. 28–32.)

Koren, J., and Danielssen, D. C. (*continued*).

Observations sur le Développement des Astéries, pp. 55–59.

In Fauna Littoralis Norvegiæ. [2de Liv. Bergen, *1856*. See (p. 131) Sars, Koren, and Danielssen.]

(*Pteraster militaris* M. & T., Pl. VIII. figs. 1–8.)

Observations on the Development of the Starfishes. *Ann. Mag. Nat. Hist.*, XX. pp. 132–136. *1857*.

Transl. from *Fauna Lit.*, Pt. II. p. 55, by W. S. Dallas.

Fauna Littoralis Norvegiæ. Part 3d. 163 pp., 16 pl. Bergen, *1877*. Edited by Koren and Danielssen.

(Young *Stichopus natans*, p. 58, Pl. VII.)

Kowalevsky, A.

Beiträge zur Entwickelungsgeschichte der Holothurien. *Mém. Acad. Impér. Sci. St. Pétersbourg* [7], XI. No. 6. 8 pp., 1 pl. *1867*.

(Development of *Psolinus brevis*.)

Krohn, August.

Beitrag zur Entwickelungsgeschichte der Seeigellarven. 35 pp., 2 pl. Heidelberg, *1849*.

(Early stages of the Pluteus of *Echinus lividus* Lam., raised by artificial fecundation.)

Beobachtungen aus der Entwickelungsgeschichte der Holothurien und Seeigel. *Arch. f. Anat. Physiol. u. wissensch. Med.*, pp. 344–352, Pl. XIV. figs. 2–5. *1851*.

Ueber die Entwickelung einer lebendig gebärenden Ophiure. *Arch. f. Anat. Physiol. u. wissensch. Med*, pp. 338–343, Pl. XIV. fig. 1. *1851*.

(*Ophiolepis squamata*.)

Ueber einige niedere Thiere. *Arch. f. Anat. Physiol. u. wissensch. Med.*, pp. 137–141. *1853*.

(Pluteus of *Echinus brevispinosus*, p. 139.)

Ueber die Larve von *Spatangus purpureus*. *Arch. f. Anat. Physiol. u. wissensch. Med.*, pp. 255–259, Pl. VII. *1853*.

Ueber die Entwickelung der Seesterne und Holothurien. *Arch. f. Anat. Physiol. u. wissensch. Med.*, pp. 317–321, Pl. VII. fig. 7. *1853*.

Ueber die Larve des *Echinus brevispinosus*. *Arch f. Anat. Physiol. u. wissensch. Med.*, pp. 361–364, Pl. XI. *1853*.

(Two figs., by Gegenbaur.)

Beobachtungen über Echinodermenlarven. *Arch. f. Anat. Physiol. u. wissensch. Med.*, pp. 208–213, Pl. X. figs. 1, 2. *1854*.

(*Tornaria*.)

Ueber einen neuen Entwickelungsmodus der Ophiuren. *Arch. f. Anat. Physiol. u. wissensch. Med.*, pp. 369–375, Pl. XIV. B. *1857*.

Lacaze-Duthiers, Henri de.

Note sur une Station d'une Enerine vivante *(Pentacrinus Europæus)* sur les Côtes de France. *Comptes Rendus, Acad. Sci., Paris,* LXIX. pp. 1253–1256. *1869.*

Note sur une Nouvelle Forme du Proembryon des Échinodermes (Stellérides, *Asteriscus verruculatus* M. et Tr.). *Comptes Rendus,* LXXVIII. pp. 24–30. *1874. Arch. Zool. Expér.,* III. pp. 15–23. *1874.*

Abstr. *Revue Mag. Zool., Paris* [3], II. pp. i–iii. *1874.*

Lankester, E. R. *See also* (p. 119) **Gegenbaur, Carl.**

On the Primitive Cell-Layer of the Embryo as the Basis of Genealogical Classification of Animals, and on the Origin of Vascular and Lymph Systems. *Ann. Mag. Nat. Hist.* [4], XI. pp. 321–338, 7 cuts. *1873.*

Leuckart, Rudolph.

Bericht über die wissenschaftlichen Leistungen in der Naturgeschichte der niederen Thiere während der Jahre 1848–75. *Arch. f. Naturgesch.,* 1854–61, 1863, 1864, 1866, 1868, 1870, 1872, 1875.

Ueber die Morphologie und die Verwandtschaftsverhältnisse der wirbellosen Thiere. 180 pp. Braunschweig, *1848.*

(Echinodermata, p. 31.)

Article "Zeugung," R. Wagner, *Handwörterbuch der Physiologie,* IV. p. 707. *1853.*

Loriol, P. de.

Crinoides. Terrain Jurassique. Paléont. française. XI. 48 pp., 12 pl. Paris, *1882.* Ie Sér. Animaux Invertébrés.

(Copies of figures of young Comatulæ.)

Lovén, S.

Om *Leskia mirabilis* Gray. *Öfvers k. Svensk. Vetensk. Akad. Förhandl.,* pp. 431–440. *1867.*

See also (p. 125) Lütken on *Leskia mirabilis* Gray.

(Homologies of Crinoids and young of Comatulæ and other Echinoderms discussed.)

Note on Hyponome Sarsi, a recent Cystidean. *Ann. Mag. Nat. Hist.* [4], IV. pp. 159, 160. *1869. Can. Nat. Geol.* [2], IV. pp. 265–267. *1869.* Transl. from *Förhandl. Skand. Naturf. Christiania,* X. p. liv. *1868.*

Om Echinodeermas byggnad. *Öfversk. k. Svens. Vetensk. Akad. Förhandl.,* pp. 1–47, Pl. XIX. *1871.*

Transl. in *Archiv. f. Naturgeschichte,* XXXIX. 1873, I. p. 16. *Ann. Mag. Nat. Hist.* [4], X. 1872, pp. 285, 376, 427. See also *Comptes Rendus de l'Académie des Sciences,* LXXV. p. 803. *1873.*

(Development of test of *Toxopneustes dröbachiensis.* Also in "Études sur les Echinoidées.")

Lovén, S. (*continued*).

Études sur les Échinoidées. *K. Svensk. Vetensk. Akad. Handl. Stockholm*, XI. Pt. II. pp. 1–91, A–H, 53 pl. *1874.* Separate. *1875.*

Abstr.: *Journ. Zool.*, V. pp. 102–105. *1876.*

(Development, *passim*; *Toxopneustes dröbachiensis*. Pl. XVII., XXI.; young anal systems, *Mellita*, *Echinarachnius*, *Asterias glacialis*.)

Lubbock, Sir John.

On the Origin and Metamorphoses of Insects. Nature Series. xvi + 108 pp. 6 pl., 59 cuts. London, *1874.*

(Metamorphoses of Echinodermata, pp. 54–61.)

Ludwig, Hubert. *See also* (p. 115) **Carus.**

Ueber die Eibildung im Thierreiche. *Arbeiten aus dem zool.-zoot. Inst. Würzburg*, I. pp. 287-510, Pl. XIII.–XV. *1874.*

(Von der Eibildung bei den Echinodermen, p. 293. *Amphidetus cordatus*, *Solaster papposus*, *Astropecten aurantiacus*.)

Beiträge zur Anatomie der Crinoideen. *Zeitschr. f. wissensch. Zool.*, XXVIII. pp. 255-353, Pl. XII.–XIX. *1877.* *Morphol. Studien an Echin.*, pp. 1–99. *1877–79.*

Zur Anatomie des *Rhizocrinus lofotensis* M. Sars. *Zeitschr. f. wissensch. Zool.*, XXIX. pp. 47–76, Pl. V., VI. *1877.* *Morphol. Studien an Echin.*, pp. 101–130. *1877–79.*

Beitrage zur Anatomie der Asteriden. *Zeitschr. f. wissensch. Zool.*, XXX. pp. 99–162, Pl. V.–VIII. 2 cuts. *1878.* *Morphol. Studien an Echin.*, pp. 150–212. *1877–79.*

Beiträge zur Anatomie der Ophiuren. *Zeitschr. f. wissensch. Zool.*, XXXI. pp. 346–394, Pl. XXIV.–XXVII. 1 cut. *1878.* *Morphol. Studien an Echin.*, pp. 241–289. *1877–79.*

Ueber die Genitalorgane der *Asterina gibbosa*. *Zeitschr. f. wissensch. Zool.*, XXXI. pp. 395–400, Pl. XXVIII. *1878.* *Morphol. Studien an Echin.*, pp. 290–295. *1877–79.*

Die Bursae der Ophiuriden und deren Homologon bei den Pentremiten. *Nach. k. Gesellsch. Wissensch. Göttingen*, pp. 215–220. *1878.*

Morphologische Studien an Echinodermen. I. Band, Abhandlungs I.–IX. iv + 300 pp., 23 pl., 5 cuts. Leipzig, *1877-79.* See also Band II. Entwick. d. Ophiur. Skelet.

Collected from Vols. XXVIII., XXIX., XXX., and XXXI., *Zeitschr. f. wissensch. Zool.*

(Contains anatomy of the genital organs, and remarks on the development of the different orders of Echinoderms.)

Ueber d. primären Steinkanal d. Crinoiden nebst vergleichende-anatomischen Bemerkungen ü. d. Echinodermen überhaupt. (Separate, 34 pp.) *Zeitschr. f. wissensch. Zool.*, XXXIV. pp. 310–332, Pl. XII., XIII. *1880.*

Ludwig, Hubert (*continued*).

Die Bildung der Eihülle bei *Antedon rosacea*. *Zool. Anzeig.*, III., No. 65, pp. 470–471, 3 cuts. *1880.*

Ueber eine lebendiggebärende Chirodota. *Zool. Anzeig.*, III. p. 492. *1880.*

Ueber eine Lebendiggebärende Synaptide und zwei andere neue Holothurien arten der Brasilianischen Küste. *Arch. Biol.* (publiées par E. Van Beneden et Ch. Van Bambeke), II. pp. 41–58, Pl. III. *1881.*

Abstr. *Journ. Roy. Micr. Soc.* [2], I. pp. 606, 607. *1881.*

Zur Entwickelungsgeschichte des Ophiurenskelettes. *Zeitschr. f. Wiss. Zool.*, XXXVI. pp. 181–200, Pl. X., XI. *1881.* *Ludwig Morphol. Studien*, II. pp. 91–110.

Lütken, Chr. F.

Bidrag til Kundskab om Echiniderne. *Vidensk Meddel. f. d. naturh. Forening i Kjöb.*, pp. 69–208, 368–371, Pl. I., II. Kjöbenhavn, *1863.* Also separate, *1864.*

(Young *Mellita*, *Clypeaster*, *Encope*, Pl. II.)

On *Leskia mirabilis* Gray, by S. Lovén. *Geol. Mag.*, V. pp. 179–184. *1868.*

See (p. 123) Lovén's article on "Leskia."

Endnu et Par Ord om de gamle Söliliers "Snabel" og Mund, with French Résumé. *Vidensk. Med. fra d. naturh. Forening i Kjöbenhavn for* 1869, No. 9–13. pp. 160–188. Cuts.

See also (p. 114) Billings, E., and (p. 123) Lovén.

Hyponome Sarsi: a recent Australian Echinoderm, closely allied to the Palæozoic Cystidea, described by Prof. Lovén; with some Remarks on the Mouth and Anus in the Crinoidea and Cystidea. *Can. Nat. Geol.* [2], IV. pp. 267–270. *1869.*

See also (p. 114) Billings and (p. 123) Lovén.

Ophiuridarum novarum vel minus cognitarum descriptiones nonnullae. *Overs. k. Dansk. Vidensk. Selsk. Forhandl.*, pp. 74–158, Pl. I., II. *1872.* Abstract, transl. by W. S. Dallas in *Ann. Mag. Nat. Hist.* [4], XII. pp. 323–337, 391–399. *1873.*

Om Selvdeling hos Echinodermer og andre Straaldyr. *Overs. k. Dansk. Vidensk. Selsk. Forhandl.*, pp. 108–158. Cuts. *1872.*

(French résumé.)

Résumé du Mémoire intitulé: Description de quelques Ophiurides nouveaux ou peu connus avec quelques Remarques sur la Division spontanée chez les Rayonnés. . . . Ophiurid. nov. . . . descr. nonnullae. *Overs. k. Dansk. Selsk. Forhandl.*, pp. 25–55. *1872.*

Lyman, Theodore.

Ophiuridæ and Astrophytidæ. *Illust. Cat. Mus. Comp. Zool.*, No. 1. Cambridge, *1865.*

(Young *Amphiura squamata* Sars, pp. 121–123.)

Lyman, Theodore (*continued*).

Ophiuridæ and Astrophytidæ, Old and New. (*1874.*) *Bull. Mus. Comp. Zool.*, III. pp. 221–272. *1871–76.*

(Young Ophiuridæ, *passim.*)

Zoölogical Results of the "Hassler" Expedition. II. Ophiuridæ and Astrophytidæ. *Illust. Cat. Mus. Comp. Zool.*, No. 8. Cambridge, *1875.*

(Young of *Ophiacantha marsupialis*, sp. nov., pp. 13–14, Pl. I. fig. 9.)

Ophiuridæ and Astrophytidæ of the "Challenger" Expedition. Pt. II. *Bull. Mus. Comp. Zoöl.*, VI. No. 2. Cambridge, *1879.*

(Young of *Astrophyton Agassizii*, *Euryale asperum*, p. 60, Pl. XIX. figs. 494, 495, 500, 501.)

The Voyage of H. M. S. "Challenger." Zoölogy — Ophiuridea. Vol. V. Part IV. 378 pp., Pl. I.–XLVIII. London and Edinburgh, *1882.*

(Young Ophiuridæ, *passim*, Plates XXVIII. fig. 10; XXXVI. fig. 1–16; XL. figs. 11, 12; XLIV. fig. 16; XLV., XLVI., XLVII. figs. 2–5.)

Marion, A. F.

Reproductions hybrides d'Échinodermes. *Journ. Zool.*, II. pp. 304–307. *1873. Comptes Rendus, Acad. Sci., Paris*, LXXVI. pp. 963–966. *1873.*

(*Sphærechinus brevispinosus* and *Toxopneustes lividus.*)

Martens, E. von.

Selbsttheilung bei Seesternen. *Naturforscher*, No. 11, pp. 103, 104. *1879.*

Meissner, G.

Ueber die Befruchtung des Eies von *Echinus esculentus. 1855. Verhandl. d. Naturf. Gesellsch. Basel*, I. pp. 374, 375. *1854–57.*

Metschnikoff, Elias.

Ueber eine Larve v. Balanoglossus. *Archiv. f. Anat. u. Physiol.* 1866, p. 592, Pl. XVII. B. Also *Berichte der Versamml. Deutscher Naturf. u. Aertzte in Hanover*, 1865.

Entwickelungsgeschichtliche Beiträge. *Mél. Biol. St. Pétersbourg*, VI. pp. 709–732. *1866–68.*

I. Metamorphose der Auricularia. *Mél. Biol. St. Pétersbourg*, VI. pp. 709–711. *1866–68.*

II. Entwickelung von *Ophiolepis squamata. Mél. Biol. St. Pétersbourg*, VI. pp. 711–712. *1866–68.*

III. Metamorphose der Ophiuren. *Mél. Biol. St. Pétersbourg*, VI. pp. 712–713. *1866–68.*

IV. Metamorphose der Seeigel. *Mél. Biol. St. Pétersbourg*, VI. pp. 713–715. *1866–68.*

Studien über die Entwickelung der Echinodermen und Nemertinen. *Mém Acad. Impér. Sci. St. Pétersbourg* [7], XIV. No. 8, pp. 1–73, 12 pl. *1869.*

(Metamorphosis of Auricularia, Embryology of *Amphiura squamata*, Ophiuridæ, Echinoidea, Bipinnaria.)

Metschnikoff, Elias (*continued*).

Untersuchungen über die Metamorphose einiger Seethiere. I. Ueber Tornaria. *1869. Zeitschr. f. wissensch. Zool.*, XX. pp. 131–144, Pl. XIII. *1870.*

Ueber die systematische Stellung von Balanoglossus. *Zool. Anzeig.*, IV. pp. 139–143, 153–157. *1881.*

Müller, Fritz.

Letter to KEFERSTEIN in *Jahresberichte ueber die Fortschritte in der Generationslehre für* 1867, p. 203, in HENLE u. PFEIFFER'S *Archiv. f. Rationelle Medicin.*

(Heart of Tornaria.)

Müller, Johannes.

Bericht über einige neue Thierformen der Nordsee. *Archiv. f. Anat. Physiol. u. wissensch. Med.*, pp. 101–110, Pl. V., VI. *1846.*

(Pluteus, p. 108, Pl. VI. figs. 2, 3.)

Ueber die Larvenszustände und die Metamorphose der Ophiuren und Seeigel. *Monatsb. Akad. Wissensch. Berlin*, pp. 294–310. *1846.*

Also transl. by GRIFFITH in *Ann. Mag. Nat. Hist.*, XIX. pp. 433–445. *1847.*

Bemerkungen über die Metamorphose der Seeigel. *Arch. f. Anat. Physiol. u. wissensch. Med.*, pp. 113–131. *1848.*

Ueber die Bipinnarien und die Metamorphose der Asterien. *Arch. f. Anat. Physiol. u. wissensch. Med.*, pp. 84–112. *1849.*

Ueber die Larven und die Metamorphose der Holothurien. *Arch. f. Anat. Physiol. u. wissensch. Med.*, pp. 364–399. *1849.*

Fortsetzung der Untersuchungen ueber die Metamorphose der Echinodermen. *Arch. f. Anat. Physiol. u. wissensch. Med.*, pp. 452–478. *1850.*

(p. 453 Holuthurien, p. 459 Seeigel, p. 469 Asterien. Abstract of 4te Abhandl.)

Ueber die Ophiurenlarven des Adriatischen Meeres. *Arch. f. Anat. Physiol. u. wissensch. Med.*, pp. 1–20. *1851.* Abstract of MÜLLER'S 5te Abhandlung.

(1. Larve u. Metamorphose der *Ophiolepis squamata*, 2. *Ophiothrix fragilis*, 3. *Ophiolepis ciliata.*)

Bemerkungen über einige Echinodermenlarven. *Arch. f. Anat. Physiol. u. wissensch. Med.*, pp. 353–357. *1851.*

Ueber die Entwickelung der Echinodermen. *Froriep's Tagsber.*, II. No. 319, pp. 105–107. *1851.*

Ueber *Synapta digitata* und über die Erzeugung von Schnecken in Holothurien. 36 pp., 10 pl. Berlin, *1852.*

Ueber die Semitæ der Spatangoiden. *Arch. f. Anat. Physiol. u. wissensch. Med.*, pp. 1, 2. *1853.*

(Compares the fascioles of adult to vibratile chords of Plutei.)

Müller, Johannes (*continued*).

Ueber den Bau der Echinodermen. *Arch. f. Anat. Physiol. u. wissensch. Med.*, pp. 175–240. *1853.* Abstract of last Memoir in *Abhl. d. k. preuss. Akad. d. Wissensch. Berlin,* XLIV. pp. 123–219. *1854.*

On the Structure of the Echinoderms; transl. by T. H. Huxley. Abstr. in *Archiv. f. Anat. Phys. u. Wiss. Med.*, pp. 175–240, *1853,* of Huxley's article in *Ann. Mag. Nat. Hist.* [2], XIII. pp. 1–24, 112–123, 241–256. *1854.*

Eine Fortsetzung der Beobachtungen über die Entwickelung der Echinodermen. *Monatsb. Akad. Wissensch. Berlin,* pp. 589–593. *1854.*

Ueber den Canal in den Eiern der Holothurien. *Arch. f. Anat. Physiol. u. wissensch. Med.*, pp. 60–68. *1854.*

Fortsetzung der Beobachtungen über die Metamorphose der Echinodermen. I. Nachtrag zu den Seeigel Larven, p. 67. II. Nachträge zu den Asteridlarven, p. 78. *Arch. f. Anat. Physiol. u. wissensch. Med.*, pp. 67–89. *1855.*

Ueber die Larven und die Metamorphose der Echinodermen. Seven memoirs from the *Abhandl. d. k. preuss. Akad. d. Wissensch. Berlin,* 1848, 1849, 1850, 1852, 1853, 1855.

Ueber die Larven und die Metamorphose der Ophiuren und Seeigel. [*1846.*] *Abh. k. preuss. Akad. Wissench. Berlin,* pp. 273–312, 7 pl. *1848.*

Also separate, 25 pp., 7 pl. Berlin, *1848.*

(*Pluteus paradoxus,* and its metamorphosis to Ophiura. Transformations of a Pluteus with epaulettes into a Sea-urchin.)

Ueber die Larven und die Metamorphose der Echinodermen. Zweite Abhandlung. [*1848.*] *Abh. k. preuss. Akad. Wissensch. Berlin,* pp. 75–109, 5 pl. *1849.*

Also separate, 37 pp., 5 pl. Berlin, *1849.*

(I. On the Bipinnariæ; II. On Brachiolaria, Auricularia, Tornaria; III. On the Metamorphoses of Echinoderms.)

Ueber die Larven und die Metamorphose der Holothurien und Asterien. [Pt. 3.] [*1849–50.*] *Abh. k. preuss. Akad. Wissensch. Berlin,* pp. 35–72, 7 pl. *1850.*

Also separate, 40 pp., 7 pl. Berlin, *1850.*

(Auriculariæ with calcareous wheels, Holothurian pupæ, Holothurian larvæ with balls, worm-shaped Starfish larva.)

Ueber die Larven und die Metamorphose der Echinodermen. Vierte Abhandlung. [*1850-51.*] *Abh. k. preuss. Akad. Wissensch. Berlin,* pp. 37–86, 9 pl. *1852.*

Also separate, 50 pp., 9 pl. Berlin, *1852.*

(Auricularia and Holothuria with balls and calcareous wheels, larvæ of *Echinus lividus, Echinus pulchellus,* Spatangoid larvæ, Bipinnaria, Tornaria, worm-shaped Starfish larva, structure of eggs of Echinoderms.)

Müller, Johannes (*continued*).

Ueber die Ophiurenlarven des Adriatischen Meeres. [Pt. 5.] [*1851.*] *Abh. k. preuss. Akad. Wissensch. Berlin,* pp. 33–61, 8 pl. *1852.*

Also separate, 29 pp., 8 pl. Berlin, *1852.*

(*Pluteus bimaculatus*, Larva and Metamorphosis of *Ophiothrix fragilis* M. T., *Pluteus paradoxus.*)

Ueber den allgemeinen Plan in der Entwickelung der Echinodermen. [Pt. 6.] [*1852.*] *Abh. k. preuss. Akad. Wissensch. Berlin,* pp. 25–65, 8 pl. *1853.*

Also separate, 41 pp., 8 pl. Berlin, *1853.*

Ueber die Gattungen der Seeigellarven. [*1853.*] Siebente Abhandlung ueber die Metamorphose der Echinodermen. *Abh. k. preuss. Akad. Wissench. Berlin,* pp. 1–55, 9 pl. *1855.*

Separate, 55 pp., 9 pl. Berlin, *1855.*

(Larvæ of Echinus, of Echinocidaris, of Spatangoids, of Echinocyamus?, *Pluteus paradoxus*, Bipinnaria, Brachiolaria. This part also contains a complete index to the seven Memoirs on the Embryology of Echinoderms.)

Ueber den Bau der Echinodermen. [*1853.*] *Abh. k. preuss. Akad. d. Wissensch. Berlin,* XLIV. pp. 123–219, 9 pl. *1854.*

Also separate, 97 pp., 9 pl. Berlin, *1854*

(On development, *passim.*)

Müller, Johannes, and Troschel, Franz Herrmann.

Ueber die Gattungen der Ophiuren. *Arch. f. Naturgesch.*, pp. 326–330. *1840.* Transl. Ofiurernes Inddeling i Slaegter in Kröyer's *Naturhistorisk. Tidsskrift,* III. pp. 535–545. *1840–41.*

(Ophionyx.)

System der Asteriden. viii + 134 pp., 12 pl. Braunschweig, *1842.*

(Pl. IX. Young Ophiothrix = *Ophionyx armata.*)

Müller, H. *See* (p. 118) **Gegenbaur.**

Neumayr, M.

Morphologische Studien über fossile Echinodermen. *Sitzungsb. der K. Akad. d. Wiss. Wien,* LXXXIV. 1 Abth. pp. 143–176, 2 pl. June, *1881.*

(Comparisons with embryonic forms, *passim.*)

Oersted, A. S.

[Direct Development of *Synaptula vivipara.*] *Vidensk. Med. fra den Naturfor. Foren i Kjöbenhavn for* 1849–50, VII.

Packard, A. S., Jr.

Life Histories of Animals including Man or Outlines of Comparative Embryology. 239 pp., 268 figs. New York, *1876.* Embryology of Echinoderms, pp. 77–92, figs. 72–96.

Perez, J.

Sur la Fécondation de l'Œuf chez l'Oursin. *Comptes Rendus, Acad. Sci., Paris,* LXXXIV. pp. 620–622; LXXXV. pp. 353, 354. *1877. Ann. Mag. Nat. Hist.* [4], XX. pp. 156–158. *1877.*

Perrier, Edmond.

Recherches sur l'Anatomie et la Régénération des Bras de la *Comatula rosacea* (*Antedon rosaceus* Linck). *Arch. Zool. Expér.,* II. pp. 29–86, Pl. II.–IV. *1873. Ann. Mag. Nat. Hist.* [4], XI. pp. 466–468. *1873.*
Abstr. *Comptes Rendus,* LXXVI. pp. 718–720. *1873.*

Les Colonies Animales et la Formation des Organismes. 798 pp., 2 pl., 158 cuts. Paris, *1881.*

(Livre IV. p. 575, *passim*, development of Echinodermata.)

Peters, W.

Ueber das Geschlecht der Seeigel. *Arch. f. Anat. Physiol. u. wissensch. Med.,* pp. 143, 144. *1840.*

(In Sea-urchins sexes are separate.)

Philippi, R. A.

Beschreibung zweier Missgebildeter See-Igel, nebst Bemerkungen über die Echiniden überhaupt. *Arch. f. Naturgesch.,* I. pp. 241–248. *1837.*

(p. 244, Ueber das Wachsthum der Echiniden.)

Beschreibung einiger neuen Echinodermen nebst kritischen Bemerkungen ueber einige weniger bekannte Arten. *Archiv. f. Naturg.,* I. p. 344, 1 pl. *1845.*

(*Hemiaster* carries young in sunken ambulacra.)

Pourtalès, L. F. de.

Reports on the Dredging Operations of the U. S. Coast Survey Steamer "Blake." II. Corals and Crinoids. Description of a Young Holopus. *1878. Bull. Mus. Comp. Zool.,* V. p. 213. Dec. *1878.*

(Pl. II. figure of young Holopus, by A. Agassiz.)

Quatrefages, A.

L'Ophiure Grisâtre est vivipare. *Comptes Rendus, Acad. Sci., Paris,* XV. p. 799. *1842.*

Métamorphoses de l'Homme et des Animaux. Paris, *1862.*
English transl. by Henry Lawson. 284 pp. London, *1864.*

(Chapter XVII. p. 172, Geneagenetic Phenomena of Radiata.)

Rathke, H.

Ueber das Geschlechtsverhältniss bei den Secigeln und Seestern. *Froriep's Neue Notizen,* XIII. pp. 65–67. *1840.*

Sars, George Ossian.

On Some Remarkable Forms of Animal from the Great Deeps off the Norwegian Coast. II. Researches on the Structure and Affinity of the Genus Brisinga, based on the Study of a New Species, *Brisinga cornata;* with 4 copperplates and 3 autographic plates. 112 pp. Christiania, *1875.*

(Young Brisinga, Pl. IV.)

Sars, Michael.

Beskrivelser og Iagttagelser over nogle mærkelige eller nye i Havet ved den Bergenske Kyst levende Dyr af Polypernes, Acalephernes, Radiaternes, Annelidernes og Molluskernes Classer. . . . Bergen, *1835*.

(p. 37, Pl. XV. fig. 40, *Bipinnaria asterigera*.)

Ueber die Entwickelung der Seesterne, Fragment aus meinen Beiträge zur Fauna von Norvegen. *Archiv. f. Naturgeschichte*, 1844, I. pp. 169–178, Pl. VI. figs. 1–22.

(Direct development of *Echinaster sanguinolentus* and *Asteracanthion Mülleri*.)

Also translated in *Ann. d. Sci. Nat.* [3], 1844, II. p. 190, 1 pl.; and in *Ann. Mag. Nat. Hist.*, 1844, XIV. p. 233; *Froriep's Neue Notizen*, XXXIII. No. 721, 1845, pp. 263–269; *Archiv. f. Anat. Phys. u. Wiss. Med.*, 1842, p. 330.

Fauna Littoralis Norvegiæ. Erstes Heft. 94 pp., 10 pl. Christiania, *1846*. VI. Beobachtungen über die Entwickelung der Seesterne. pp. 47, 1. *Echinaster sanguinolentus*, Pl. VIII. figs. 1–37; p. 56, 2. *Asteracanthion Mülleri*, Pl. VIII. figs. 38–43.

For continuation, see (p. 131) Sars, Koren, and Danielssen.

Oversigt af Norges Echinodermer. Christiania, *1861*. vi + 160 pp., 16 pl.

(Pl. VI. figs. 3–13. Development of *Pteraster militaris*, pp. 57–62.)

Om en ny Art Brachiolaria. *Forhandl. Vidensk. Selsk. Christiania*, pp. 126–137. *1863*.

Geologiske og Zoologiske Iagttagelser, anstillede paa en Reise i en Deel af Trondhjems Stift i Sommeren 1862. *Nyt Mag. Naturv. Christiania*, XII. pp. 253–272. Also separate. 88 pp. Christiania, *1863*.

(Young of *Amphiura squamata*, new species of Brachiolaria, p. 72.)

Mémoires pour servir à la Connaissance des Crinoïdes vivants. Programme de l'Université Royale de Norvège. Christiania, *1868*. 65 pp., 6 pl.

(II. Pentacrinoïde de l'*Antedon Sarsii* (Alecto) Düben et Koren, Pl. V. et VI.)

Sars, M., Koren, J., and Danielssen, J. C. *See also* (p. 121) Koren and Danielssen.

Fauna Littoralis Norvegiæ. 2de Livraison. 101 pp., 12 pl. Bergen, *1856*.

(pp. 46–54. Development of *Holothuria tremula*, Pl. VII., VIII. figs. 28–32. pp. 55–59. Development of *Pteraster militaris*, Pl. VIII. figs. 1–8.)

Fauna Littoralis Norvegiæ. Part 3d. Edited by Koren and Danielssen. 163 pp., 16 pl. Bergen, *1877*.

(p. 58. Young *Stichopus natans*, Pl. VII. See also (p. 122) Koren and Danielssen.)

Schneider, Anton.

Ueber Befruchtung *(Asteracanthion glaciale)* = *A. rubens*. (See p. 336, *Zool. Anzeig.*, III.) *Zool. Anzeig.*, III. pp. 252–257, 336. *1880*.

Schultze, M.

Ueber die Entwickelung von *Ophiolepis squamata*, einer lebendiggebährenden Ophiure. *Arch. f. Anat. Physiol. u. wissensch. Med.*, pp. 37-46, Pl. I. *1852.*

Selenka, Emil.

Zur Entwickelung d. Holothurien *(Holothuria tubulosa* und *Cucumaria doliolum).* Ein Beitrag zur Keimblättertheorie. *Zeitschr. f. wissench. Zool.*, XXVII. pp. 155–178, Pl. IX.-XIII. *1876. Zeit. gesammt. Naturw. Berlin* [2], XIII. pp. 108, 109. *1876.*

Abstr. *Sitzungsb. phys.-med. Ges. Erlangen.* June and Dec. *1875.*

Sur le Développement des Holothuries. Abstr. *Arch. Zool. Expér.*, V. pp. xxvi.-xxxi. *1876.*

Beobachtungen über die Befruchtung und Theilung des Eies von *Toxopneustes variegatus.* Vorläufige Mittheilung. *1877. Sitzungsb. phys -med. Ges. Erlangen*, X. pp. 1-7. *1877-78.*

Zoologische Studien. I. Befruchtung des Eies von *Toxopneustes variegatus.* Ein Beitrag zur Lehre von der Befruchtung und Eifurchung. 38 pp., 3 pl. Leipzig, *1878.*

Keimblätter u. Organanlage der Echiniden. *Zeitschr. f. wissensch. Zool.*, XXXIII. pp. 39-54, Pl. V.-VII. *1880.*

Also abstr. *Sitzungsb. phys.-med. Ges. Erlangen*, pp. 100–108. Mai, *1879.*

(Early stages of *Echinus miliaris, Toxopneustes brevispinosus, Strongylocentrotus lividus, Arbacia pustulosa, Echinocardium cordatum.*)

Semper, Carl.

Ueber einige tropische Larvenformen. *Zeitschr. f. wissensch. Zool.*, XVII. pp. 407-428. *1867.*

(Discussion of radiate type of Echinoderms, p. 415.)

Reisen im Archipel der Philippinen. Pt. 2. Wissenschaftliche Resultate. I. Holothurien. 288 pp., 40 pl. Leipzig, *1868.*

(Description of genital organs of many genera; general discussion of development in IV. Das System.)

Simroth, H.

Anatomie und Schizogonie der *Ophiactis virens* Sars. [Ein Beitrag zur Kenntniss der Echinodermen.] *Zeitschr. f. wissensch. Zool.*, XXVII. pp. 417-485, 555-560, Pl. XXXI.-XXXV.; XXVIII., pp. 419-526, Pl. XXII.-XXV. *1876, 1877.*

Sladen, W. P.

On the Asteroidea and Echinoidea of the Korean Seas. *1878. Journ. Linn. Soc. Zöol. London*, XIV. pp. 424-445, Pl. VIII. *1879.*

(Describes some young Temnopleuridæ and Echinocardium.)

On Traces of Ancestral Relations in the Structure of the Asteroidea. *Proc. Geol. Polyt. Soc. Yorkshire*, VII. Pl. IX. *1880.*

Spengel, J. W.

Bau u. Entwickelung von Balanoglossus. *Tagebl. d. Naturf. Vers. München*, 1877.

See also transl. of Thomas H. Huxley, *A Manual of the Anatomy of Invertebrated Animals.*

Springer, Frank. *See* (p. 134) **Wachsmuth, Chas., and Springer, Frank.**

Stewart, T. H.

On the Young State of *Ophiocoma rosula*, and on the Form and Development of the Spines of this Species. *Ann. Mag. Nat. Hist.* [2], XVIII. pp. 387-391, Pl. XV. *1856.*

Studer, Th.

Ueber Echinodermen aus dem antarktischen Meere und zwei neue Seeigel von den Papua Inseln, gesammelt auf der Reise S. M. S. Corvette "Gazelle" um die Erde. *Monatsb. Akad. Wissensch. Berlin*, pp. 452–465. *1876.*

(Viviparous Echinoderms and young stages of *Goniocidaris vivipara*, p. 455; *Abatus cordatus*, p. 457; and *Ophiomyxa vivipara*, p. 462.)

Ueber Geschlechtsdimorphismus bei Echinodermen. *Zool. Anzeig.*, III. pp. 523-527, 543-546, 10 figs. *1880.*

(Sexual differences [due to growth in part] in Hemiaster.)

Uebersicht ueber die während der Reise S. M. S. Corvette "Gazelle" um die Erde 1874-76 gesammelten Echinoiden. *Monatsb. der Königl. Akad. der Wiss. zu Berlin*, pp. 861-885, Pl. I., II. Oct. 28, *1880.*

(Viviparous Echini, *passim.*)

Thomson, C. Wyville.

On the Embryology of *Asteracanthion violaceus* (L.). *Quart. Journ. Mic. Sci.*, I. pp. 99-108, Pl. VII. *1861.*

On the development of *Synapta inhærens* O. F. Müller sp. *Quart. Journ. Mic. Sci.*, II. pp. 131-146, Pl. V., VI. *1862.*

On the Embryology of the Echinodermata. *Nat. Hist. Review, London*, III. pp. 395-415, figs. 1-6. *1863.*

(General review of the subject to date: Part I. Bipinnaria; II. Brachiolaria; III. *Asteracanthion violaceus*, *A. Mülleri* and *E. sanguinolentus*; IV. *Pteraster militaris* and *A. glacialis*; V. Vermiform Larva.)

On the Embryology of the Echinodermata. VI. The Embryology of the Echinidea. *Nat. Hist. Review*, pp. 581–611, figs. 7–16. *1864.*

Concluded from *Nat. Hist. Rev.*, III. p. 415. *1864.*

On the Embryogeny of *Antedon rosaceus* Linck. (*Comatula rosacea* Lam.). [*1863.*] *Philos. Trans. Roy. Soc. London*, CLV. pp. 513-544, Pl. XXIII.-XXVII. *1865.*

Notice of some Peculiarities in the Mode of Propagation of certain Echinoderms of the Southern Sea. *1876. Journ. Linn. Soc. London*, XIII. pp. 55-79, 13 cuts. *1876-78.*

(Direct development of Holothurians, Starfish, Sea-urchins, and Ophiurans, *Cladodactyla crocea*, *Psolus ephippifer*, *Cidaris nutrix*, *Goniocidaris canaliculata*, *Hemiaster sp. Archaster excavatus*, *Hymenaster nobilis*, *Ophicoma didelphys.*)

Thompson, J. V.

On the Star-fish of the Genus Comatula, demonstrative of the *Pentacrinus Europæus* being the young of our Indigenous Species. *1835.* Abstr. *Proc. Phil. Trans. Roy. Soc. London*, p. 339. *1830-37. Edinb. New Phil. Journal*, XX. pp. 295-300, Pl. II. *1836. Froriep's Notizen*, XLIX. pp. 1-5, figs. 1-10. *1836. L'Institut*, p. 332. *1835. Oken's Isis.*, pp. 73-75. *1838.*

Verrill, A. E.

Notes on Radiata in the Museum of Yale College, with Descriptions of New Genera and Species. *Trans. Conn. Acad.*, I. pp. 247-596. *1866-71.* Separate. 368 pp. *1867-69.*

(Mentions young of several species of Echinoderms, *passim.*)

Echinodermata (in "Contributions to the Natural History of Kerguelen Islands," by J. H. KIDDER. II.). *Bull. U. S. Nat. Mus.*, III. pp. 66–75. Washington, *1876.*

(Mentions young Hemiaster.)

Wachsmuth, Charles.

Internal and External Structure of Palæozoic Crinoids. *Amer. Journ. of Science*, 1877, p. 126.

Wachsmuth, Charles, and Springer, Frank.

Transition Forms in Crinoids, and Description of five New Species. *Proc. Acad. Nat. Sci. Phila.*, pp. 224–266. *1878.*

Revision of the Palæocrinoidea. I., II. *Proc. Acad. Nat. Sci. Phila., 1879-81.*

Part I. The Families Ichthyocrinidæ and Cyathocrinidæ. *Proc. Acad. Nat. Sci. Phila.*, pp. 226-378. Nov. 4, *1879.*

Part II. Family Sphæroidocrinidæ, with the Sub-Families Platycrinidæ, Rhodocrinidæ, and Actinocrinidæ. *Proc. Acad. Nat. Sci. Phila.*, pp. 177-414. July 26, *1881.*

(Comparison of fossils with young stages of Comatulæ, *passim.*)

Walch, J. E. J.

*Abhandlung von der Reproduction der Seesterne. *Der Naturforscher*, 1774, pp. 57-66.

Zittel, Karl A.

Handbuch der Palaeontologie: München u. Leipzig, *1876-80.* I. Abth. I. pp. 308-560, figs. Echinodermata. *1879.*

(Comparison of young stages of Crinoids, Echini, and other Echinoderms to fossils.)

Zoölogical Record ("The Record of Zoölogical Literature").

Reports on Echinodermata, *passim*, I.-XVII. *1864-80.* London, *1865-1881.*

CAMBRIDGE, MASS., August 15, 1882.

No. 3. — *On a Revision of the Ethmoid Bone in the Mammalia, with special Reference to the Description of this Bone and of the Sense of Smelling in the Cheiroptera.* By Harrison Allen, M. D., Professor of Physiology in the University of Pennsylvania.

In the Bulletin of the Museum of Comparative Zoölogy dated February, 1880, I described briefly some peculiarities of structure I had detected in the ethmoid bone of the Cheiroptera.* It is my purpose in this communication to extend my remarks in the same direction, and by way of introduction to give a brief account of the ethmoid bone as it is met with in the mammals generally.

The ethmoid bone in mammals lies within the ethmoidal notch of the frontal bone, and is in all but a few groups (e. g. in Primates, Quadrumana, and some of the genera of Felidæ) protected laterally by the descending process of the frontal bone, the orbital process of the palatal bone, and the orbital process of the orbito-sphenoid bone. In the nasal chamber it is protected above by the nasal bone and in part by the vomer. Its several portions lie in the nasal chamber and in the frontal and sphenoidal sinuses. With a near approach to accuracy, it may be said that the ethmoid is included between the following openings : the optic, the ethmoidal and the sphenoidal foramina, and the lachrymal and the infra-orbital canals. The suture between the palatal bone and the superior maxilla in the roof of the mouth corresponds nearly to the anterior limit of the ethmoturbinals.

The Nomenclature of the Subdivisions of the Ethmoid Bone. — The ethmoid bone of the human subject is described by anatomical writers as composed of a pair of lateral masses, sponges, or labyrinths, united to a perpendicular plate by means of the cribriform plate, the projection of the former above the latter constituting the crista-galli. Each lateral mass in turn is composed of ethmoid cells, and presents upon its median surface two scrolls. The "cones of Wistar" are a pair of symmetrical ossicles appended to the lateral masses posteriorly, and are not of olfactory significance.

* The prodrome of this memoir, as announced in the above-named paper, has not been followed in all respects. The points of difference, however, do not demand special attention.

The departures from this arrangement in the ethmoid of quadrupeds are so numerous and pronounced that an adherence to a similar plan of description is not satisfactory.

In proposing modifications, I will use the following language : —

The ethmoid bone is composed of the *meso-ethmoid* and two *ethmoturbinals.* The former includes the perpendicular plate and the crista galli ; the latter, as in human anatomy, the lateral masses of the bone. These terms are in general use by English writers. The *nasoturbinal* is an ethmoturbinal plate projecting in front of the remaining plates, and forming the superior limit to the series, as seen on the median surface of a longitudinal (sagittal) section. — The "cones of Wistar" form the *sphenoturbinals.*

Each ethmoturbinal element is an *olfactory plate.* The space between any two plates is called an *olfactory interspace.*

Each olfactory plate is, as a rule, plicated, and each plication in turn forms an *olfactory fold.* The free projecting ends of the olfactory plates constitute the *olfactory lobes.*

The ethmoturbinal plates are divided into two groups, the *ectoturbinals* and the *endoturbinals.* The *ectoturbinal plates* are those which lie in a space defined by the frontal bone and the superior maxilla. This space communicates with the nasal chamber at the interspace between the nasoturbinal and the first endoturbinal, as well as by a large oval opening behind the maxillo-turbinal and the vertical plate lying between the superior maxilla and the ethmoid. The ectoturbinal plates are arranged on the lateral sides of the chamber, from which they project inward toward one another, but never to a degree to be seen on the median surface as this is seen in a longitudinal section of the skull.

The *endoturbinal plates* are arranged in a series lying beneath as well as medianly to the foregoing. They are placed in oblique parallel rows from above downward, and are best seen in a longitudinal (sagittal) section of the skull. Each ethmoturbinal plate has a base where it arises from the cribriform plate. The upper border of each plate is its *frontal border,* while its lower border is its *palatal border.**

The space between the meso-ethmoid and the ethmoturbinal is the *septoturbinal space.* The lamina uniting the ethmoturbinals one with

* The terms ecto- and endoturbinal are named with reference to the relations they entertain to the nasal chamber. The ectoturbinals do not appear, with a few exceptions, on the lateral wall of the undissected nasal chamber (see Plate I. fig. 1), while the endoturbinals so appear, or can be made to do so, by producing the axes of the olfactory plates entering into them.

another constitutes the *transverse lamina.* Its posterior portion unites with the vomer, and may receive the name of the *turbino-vomerine lamina.* Its anterior portion lies in front of the last named. The sphenoturbinals are furnished with olfactory plates that join the vomer, thus crossing the septoturbinal space.

The surface of the ethmoid bone entering into the construction of the brain case is called the *encranial surface.* It exhibits a *perforate* or *cribriform plate*, and a *non-perforate plate* placed posteriorly to the foregoing. The perforate plate answers in position to the ectoturbinals, the endoturbinals in great part, and the septoturbinal space. The non-perforate space covers the sphenoturbinals and the lowest of the endoturbinals. The encranial surface may be subdivided, for convenience in description, into surfaces which correspond to the divisions of the ethmoid as seen from the nasal chamber. Thus the septoturbinal, the ectoturbinal, and the endoturbinal surfaces are easily distinguished.

The Literature of the Ethmoid Bone. — That the terminology of the ethmoid bone at present in use needs revision can be readily shown by a reference to the literature of the subject.

E. F. Gurlt (Handbuch der Vergleichenden Anatomie der Haus-Saugthiere, Berlin, 1843, Vol. I. p. 81) describes the ethmoid on the basis of the human bone. He identifies the nasoturbinal as the superior conch and the first endoturbinal as the middle conch. All parts not appearing on the median surface he groups under the head of the "Labyrinth."

H. Strauss-Durckheim (Anatomie Descriptive et Comparative du Chat, Paris, 1845, p. 385) gives the sphenoturbinals as equivalent to the "cornet de Bertin," and forming the third division of the bone. The second division is the group of plates seen only in the *cat* and its congeners. It is a development from the transverse lamina. All the remaining portion of the ethmoturbinal, comprising as it does the bulk of the bone, Strauss-Durckheim calls the first or superior division of the bone. The space between the two ethmoturbinals on a level with the lower border of the chamber of the ectoturbinals and the equivalent to the ethmoidal notch of human anatomy receives the name of the "écartement des anfractuosités supérieures." The mesoturbinal is named the "lame verticale moyenne."

Owen (Archetype and Homologies of the Vertebrate Skeleton, 1848) named the meso-ethmoid the prefrontal, and gave to the ethmoturbinals the name which they have since borne. In his elaborate work on the Anatomy of the Vertebrates, Owen restricts the term *ethmoturbinal* to

the lower plates only of the mass (the endoturbinals of this paper), as seen in the *hog*. In the description of the ethmoid in this animal the word "labyrinth" is also used, showing that the term had not, in the mind of the writer, supplanted that of "ethmoturbinal." — In the *tapir* the cribriform plate is said to be reticulate, with long radiating meshes. The ethmoturbinal in this animal consists of many convolute divisions, and each is perforated by many foramina. — In the *horse* the ethmoturbinal is separated from the nasoturbinal. The same language is employed in describing the ethmoids of other animals. — The *giraffe* exhibits the upper folds of the labyrinth coalescing in the moderately long and deep ethmoturbinal. — In the *dog* the horizontal folds of the "labyrinth" are four in number. Here by the word "labyrinth" the median surface of the ethmoturbinals (endoturbinals) is intended. Indeed, throughout the descriptions in this work, the term *ethmoturbinal* includes the periphery of the lateral mass, excepting that portion lying above the cribriform plate. Thus the os planum and the middle and lower plates of the median surface are ethmoturbinal, while the intervening structures and the superior division are vaguely included in the "labyrinth." This is evidently so in the account of these parts in the *giraffe*, where the upper folds of the labyrinth are said to coalesce and to be produced into the ethmoturbinal. In like manner, the ethmoturbinal forms the part identical with the transverse lamina.

J. Chatin (Les Organs des Sens dans la Série Animale, Paris, 1880, p. 241) describes each olfactory plate as it appears upon the median surface, where it is called a "cornet." The "cornet supérieur" is the same as the nasoturbinal; the "cornet ethmoidal," the equivalent of the endoturbinals. No attempt is made to describe the ethmoturbinal. It is simply stated to be most bizarre in its construction. In the *kangaroo* the maxilloturbinal is called the "volute ethmoidal."

Kitchen Parker ("On the Structure and the Development of the Skull in the Pig," Philosoph. Trans., Vol. CLXIV. Part I., 1874) calls the first plate of the ectoturbinals the "upper turbinal"; the first endoturbinal, the "middle turbinal." The maxilloturbinal forms the "lower turbinal." The nasoturbinal is called the "nasal turbinal." In advance of the olfactory region Parker recognizes two turbinals, viz. the maxilloturbinal and the alinasal turbinal. The first of these has been already noticed. The last named is a ledge-like point within the nostril continuous with the ledge supporting the maxilloturbinal. A very good general view of the ethmoid as seen in the *hog* is shown in Plate XXXV. of the above memoir, — the ectoturbinals being as yet imperfectly developed.

Dr. Elliott Coues ("Osteology and Myology of the Opossum," Memoirs of the Boston Nat. Hist. Soc., II. 62) treats of the ethmoturbinal as synonymous with the lateral mass, and of the perpendicular plate as being probably homologous with a pair of coalesced prefrontals. He further ambiguously states that the "spongy convolutions" are borne on either side of the perpendicular plate. Respecting the arrangement of the olfactory plates, he remarks, "It would be difficult even if it were desirable (!) to describe the details of the spongy convolutions."

The description in Bronn's Klassen und Ordnungen des Thier-Reichs (Bd. VI. Abtheil. X. 52) embraces a general account of the bone. No attempt is made to discriminate between the olfactory plates. The ethmoturbinal mass is named the labyrinth, and composed of thin rolled plates of bone enclosing the ethmoidal cells.

The Method employed by the Author in studying the Ethmoid Bone. — The study of the ethmoid bone is greatly facilitated by immersion of the bone in an acid solution which is sufficiently strong to remove the bone-salts. When the bone is detached from the skull, the delicate folds are easily decalcified by a solution of nitro-muriatic acid of not greater strength than eight drops of the acid to an ounce of water. When the entire skull, say of an animal of the size of a horse or dog, is subjected to the acid solution, a strength from a half-drachm to a drachm of acid to the pint of water will be required. For small, delicate skulls, such as those of the bats, a fluid slightly acidulated, say two drops to the ounce of water, is sufficient. Immersion from six to twelve hours is needed for the smaller specimens, and perhaps a renewal of the fluid for a second period as long as the first for the larger ones. The specimen is next washed and soaked through several waters, and afterwards can be preserved in alcohol. The ethmoid bone thus prepared can be studied with signal advantage over the natural bone, since a dissection can be effected with ease, and without danger of mutilation. I think perhaps the best way to obtain a satisfactory preparation for general purposes of comparison is to secure a macerated skull * of the animal whose ethmoid is desired, and, after the bone-salts have been removed, to bisect the skull longitudinally at one side of the line of the vomer, and reserve one half of the specimen for study of the median surface of the ethmoid bone. The encranial

* Care must be taken to protect the freshly macerated skull from the attacks of a voracious dipterous larva, that is capable of destroying the delicate structures of the ethmoid in an incredibly short space of time.

surface will be seen in the same specimen. Next, to make a transverse (frontal) section of the opposite piece, in such a manner as to divide transversely all the parts of the ethmoid bone directly in advance of the cribriform plate. The section must be made concentrically to the plane of the cribriform plate, and of course to include the mesoethmoid. The proximal surface of such a preparation embraces a section of the ethmoturbinals and of the septoturbinal space, and gives at a glance the plan of the bone. The parts of both specimens can be handled with freedom, as the botanist can press aside the several parts of a flower, and afterward, without violence, return them to their natural positions.

If it be desired to retain the mucous membrane in connection with the olfactory plates, the superficial parts, together with the temporal and masseter muscles and the eyes, should be first removed to enable the acidulated fluid to act directly upon the bony surfaces. After the bone-salts have been dissolved, a saw may be employed to sever the denser surrounding structures, such as the frontal bone, the zygomata, the hard palate, etc., reserving the interior parts to be divided by the scissors or the knife. By this means irregular laceration of the plates and membranes is avoided, and the parts are kept free from bone-dust.*

A General Account of the Ethmoid Bone.

At the risk of repeating here and there a fact already incorporated in the above list of terms, I will now give a succinct account of the ethmoid bone, as studied in a number of well-known mammals other than the bats.

The Encranial Surface.—The cribriform plate is divided into two portions, one lying over the septoturbinal space, and the other answering to the ethmoturbinal spaces. The latter is again divided into two portions, a superior and an inferior, which correspond to the ectoturbinal and endoturbinal spaces respectively. In the Carnivora,† so far as examined, these divisions are abruptly angulated one to the other. The line

* I desire to return my acknowledgments to the Academy of Natural Sciences of Philadelphia for the use of crania from its collection. When it is seen that a decalcified skull subsequently subjected to the making of sections of the ethmoidal region is one practically expended in the cause of science, it will be conceded that no inconsiderable privilege was accorded me.

† For purposes of comparison, the ethmoid bone of the dog and otter are figured side by side in Plate I. But the bone of the otter is not separately described.

separating them is distinctly ridged, and is conspicuous in the *raccoon* and the *dog*, but inconspicuous in the *sloth*. This ridge is the basal encranial aspect of the first endoturbinal, and the foramina ranged on the sides and at the tip of the ridge afford openings of exit to the olfactory nerves supplying the sides of the plate. Indeed, all the olfactory nerves excepting those of the septoturbinal spaces are similarly placed with respect to basal lines of the ethmoturbinal plates. The first endoturbinal, being the largest of the series, secures for its base a more decided line than is the case with the others. The septal openings are arranged in a single straight line parallel to the crista galli.

The simplest arrangement of foramina is seen when a row of openings lies parallel to the median border of the encranial surface, and another is seen similarly disposed along the lateral border. The successive degrees of complication on the surface are dependent upon the extent that the basal ridges extend medianly from the last-named row.

A general idea of the plan of the ethmoidal plates can be thus formed by the study of the encranial surface. The number of the foramina present, the size of the basal ridges, the extent of the non-perforate space, will be found to hold an exact relation to the number and size of the olfactory plates, and indirectly to the functional importance of the olfactory region.

As a rule, the encranial ectoturbinal surface is rounded in form, and of greater diameter than the surface for the endoturbinals. In the *cat* the cribriform plate is everywhere narrow, the ectoturbinal surfaces being separated by a median frontal process, on either side of which septal foramina are arranged. The crista galli is not developed at the anterior third of the endoturbinal region. The ridge for the first endoturbinal is scarcely longer than the width of the septoturbinal space at its side. The second endoturbinal closely resembles the first. The foramina of the last-named plates are continuous at the lateral border of the cribriform plate. The ridge of the third plate is indeterminate, the foramina being large and clustered.

In the *dog* (Plate I. figs. 1, 2) the ectoturbinal surface is subrounded, higher than it is broad, with the septoturbinal space widened superiorly. The ectoturbinal ridges and foramina are displayed laterally, and lie on the level of the descending portion of that portion of the frontal bone articulating with the orbitosphenoid. The first endoturbinal ridge is three times the width of the related septoturbinal space. The second is two thirds the length of the first. The third ridge is, as in the *cat*, indeterminate, and the foramina are clustered.

In both the *cat* and the *dog* the non-perforate space is exceedingly small. In the former it is reduced to a mere elevated rim, and in the latter it is concealed by the anterior edge of the presphenoid. The non-perforate space is well seen in the seal, *Phoca vitulina*, the *opossum*, and the *peccary*. In the *otter*, the *bear*, and other Carnivora, it is nearly absent, so that the posterior border of the cribriform plate is also the posterior border of the bone. The non-perforate space is in close relation with the orbitosphenoid and the presphenoid, so that the sphenoidal sinuses may be occupied by the lowest of the endoturbinals.

As is well known, the sphenoidal turbinals in *man* are distinct ossicles, lying between the ethmoturbinals and the presphenoid. In some mammals, as the sloth, the presphenoid has a group of plates which closely resemble an olfactory plate of the ethmoturbinal, but differing therefrom by the fact that the plates unite with the crest at the basal surface of the cranio-facial axis, instead of being separated by an intervening space, as in the ethmoturbinals. A slight tendency in the same direction is seen in the *peccary*. Is this group of plates homologous with the sphenoturbinals of man?

In the *otter* (Plate I. fig. 4), the *mink*, the *weasel*, and the *bear*, the frontal sinuses are occupied by the ectoturbinals. When such frontal development is pronounced, the ectoturbinal division of the ethmoid is of a circular form in transverse section and on the encranial surface, while the endoturbinal division is longer than wide.

The Nasal Surfaces. — Each ethmoturbinal plate is attached to the cribriform plate proximally, to the os planum laterally, and, it may be, to an associate-turbinal distally. Upon the median surfaces the plates remain free, and either end simply, or exhibit a tendency at their ends to form two revolute parts, the convex surfaces of which appear upon the superficies of the lateral wall of the nasal chamber. In a longitudinal section of the nose the median aspect of the ethmoturbinal is thus made up, in the last-named variety, of the rounded convexities of the plates and the spaces between them. The uppermost of the plates is much longer than the others. . . . The lateral aspect of the nasal chamber at the ethmoturbinal region is, therefore, made up simply of those plates which have a common plane. The surface gives no impression of the number of the plates present; for some may not reach the median surface, and from this circumstance be not seen or accounted for. Neither is the surface a guide to the length of the plates, since, as the reader has already seen, the cribriform plate is wider above than below,

so that a plate extending from the last-named to the median surface is of necessity longer than one extending between similar points below.

In the transverse section it will be seen that a number of the plates have failed to reach the median surface. In the *dog* (Plate I. fig. 1), for example, the ectoturbinals are four in number. The first is obliquely placed from above downward, and within outward. Two conspicuous convolutions are present at the distal end, the lower one of which alone lies toward, but not on, the median surface. The second plate possesses a single convolution, which is directed outward. The third and fourth are very short, biconvolute, and directed upward and forward. None of the ectoturbinals appear on the longitudinal surface of the nasal chamber. The first endoturbinal is long and complex. It is directed forward and upward, and nearly touches the median convolution of the first ectoturbinal. It is biconvolute, but the parts are short and not incurved. Three secondary convolutions are seen on the sides of the plate, — one on the upper, and two on the lower aspect. Both of the latter reach the surface of the longitudinal section. The second endoturbinal is the longest of the series, and touches the septum. A single primary convolution is directed upward, and much convoluted. A single upper and two lower secondary convolutions are seen, as in the first plate, but they are less conspicuous. The third and remaining plate is the smallest of the endoturbinals, and arises from the os planum, as this structure is seen in the section. It is directed upward and inward, to appear on the longitudinal section. It presents a single convolution. Immediately beneath the last plate, the transverse plate or lamina is seen. The nasoturbinal is seen in the section as a minute non-convolute structure, intermediate between the two sets of plates.

The endoturbinals are always arranged in tiers one above another. All originate from the lateral surface. In the *dog* (Plate I. fig. 2) the second of the plates descends, and may follow the curve of the sides and the bottom of the nasal chamber as far as the meso-ethmoid, along which it ascends a short distance. The plates in this portion of the ethmoturbinal in the dog are from three to four in number. The olfactory plates tend to unite anteriorly. Thus two to three plates unite to form the nasoturbinal in the *dog*. The lower endoturbinal plates unite in front by broad, thin plates. These, taken collectively, constitute the transverse lamina of Strauss-Durckheim. It is constantly present, stretching across the septoturbinal space to the vomer, against which it rests.

The ectoturbinal plates may be rudimentary or absent. They would

appear to be absent in the *ape*, at least in the adult. In *man* they are also absent. The *opossum* has two ectoturbinals; the *cat*, two to three; the *hog*, five; the *ox*, eight. In the *seal* the ectoturbinals are developed to a greater degree than the endoturbinals.

The olfactory plates are either simple at their ends or convolute. Their anterior ends are often produced forwards in a series of tongue-like projections, which have received the name of the olfactory lobes. The projection known as the nasoturbinal is the most conspicuous of these. The lobe on the first endoturbinal is always well developed. The endoturbinals of the *hog* are without marked lobulations. The Carnivora and the Rodentia, as far as examined, possess lobes on all the folds. In the *opossum* two of the plates are simple, the remainder are convolute. Occasionally a convolute fold arises from the side of a plate instead of from the end, as in the larger plates of the Carnivora and the Ruminantia. The arrangement of the endoturbinals, as seen in the median surface of the ethmoturbinals, is much the same as in other Carnivora.

The septoturbinal space is in all mammals narrow, and indeed may be obliterated here and there where the endoturbinal plates lie in contact with the septum. Such a point of contact is evident in the *macaque*, *M. nemestrinus*, where a depression is seen on the septum answering in position to the first endoturbinal plate. Similar depressions are seen in the *bats*, as in *Antrozous* and *Corynorhinus*.

In *Cebus* (Plate II. figs. 1, 2) the absence of an ectoturbinal series, and the endoturbinal series being restricted to a single plate bearing incisures upon its posterior border, and retaining upon its anterior surface a deflected and abortive nasoturbinal (uncinate process), an example is afforded of the manner after which the ethmoid bone is modified in passing from the quadrupedal form to the primate. In man the interval between the endoturbinal series and the lateral aspect of the bone is occupied by a number of cellules. These being absent in *Cebus* and *Macacus* (the only genera examined), it would appear as though the chief difference between these forms and the human ethmoid lay in the development of the ethmoid cells.

The human ethmoid bone (Plate II. fig. 3), viewed from beneath, furnishes, as in *Cebus*, an aborted nasoturbinal in the "uncinate process," and the rugose under surface of the single endoturbinal plate in the "middle turbinated bone."

A Special Account of the Ethmoid Bone in the Horse, the Peccary, the Sloth, the Cat, the Seal, and the Mole. — I have thus endeavored to

sketch the general plan of arrangement of the ethmoid bone in the mammals, and to indicate the relations that the several parts hold one to another. Before describing the bone in the Cheiroptera, I propose giving detailed accounts of the ethmoid in the cat, the seal, the peccary, the sloth, and the mole; with the object of bringing together some widely diverse examples, and presenting descriptions which will be sufficiently detailed to permit of comparisons being made with those which will follow in the concluding portion of this paper.

In the *horse* (Plate II. figs. 4, 5) the endoturbinal aspect of the encranial surface is concealed from the brain case at its upper third by a transverse plate apparently of the frontal bone, but which in reality is an ossification of the ethmoid. The foramina of the endoturbinal surface are arranged elaborately in a crescent extending across the anterior end. The foramina of the ectoturbinal surface are seen in five transverse triangular or clavate clusters.

The ethmoid, studied from its lateral aspect, exhibits a trenchant distinction between the endoturbinals and the ectoturbinals by a thin septum extending across the great cranio-facial sinus. Both the turbinal sets lie in this sinus, connected by a thin papyraceous lamina, save at the anterior fourth of the ectoturbinal series, where it is firmly connected by the ends of the olfactory plates to the descending process of the frontal bone, as well as with the line of junction this process effects with the orbitosphenoid and the frontal bones.

Seen in transverse section, the turbinal mass exhibits sharply the division between the two sets of plates. The ectoturbinals are eight in number, including the nasoturbinal. The endoturbinals are five in number, and preserve the order already described as existing in the hog. The last plate sends backward a single folium within the sphenoidal sinus, so that the olfactory apparatus extends a short distance posterior to the encranial surface.

Seen from the median aspect, the nasoturbinal is seen to assume enormous proportions, being much wider than any of the endoturbinals. Four of the endoturbinals are visible, and all are markedly biconvolute, the convexities of the scrolls alone appearing on the general surface. Anteriorly each plate is seen ending simply at the bases, but toward the apices they are more or less lobate. The first and second plates project beyond the transverse lamina.

A small but distinct plate crosses the septoturbinal space obliquely at the orifice of the sphenoid sinus. The septum is distinctly foliated opposite the third, fourth, and fifth plates.

In the peccary,* *Dicotyles torquatus* (Plate III. figs. 1 – 3), the encranial surface is uniformly concave, and presents scarcely any angulation inferiorly. Hence, the indications of separation of the ectoturbinals from the endoturbinals are indistinct. The basal aspects of the endoturbinal plates form well-defined lines on the cribriform plate, about which are arranged a number of little pits. From the bottom of these lie the foramina of the olfactory nerves. The most conspicuous of these is the one for the first endoturbinal plate. The septoturbinal surface is on a higher plane than that of the ethmoturbinals. The crista galli is distinct throughout. The non-perforate space is nearly one third the length of the cribriform plate. Of the nasal surfaces, it is seen on the frontal section that the divisions between the ectoturbinals and the endoturbinals are well defined. The former are seen to have a less complicated structure, and are arranged as converging radii from the upper and lateral walls. The endoturbinals are arranged in tiers, and constitute, with the median exposure of the nasoturbinal, the entirety of the median surface.

The ectoturbinals are nine in number. The first ectoturbinal and the nasoturbinal are confluent. The former presents a convex uniform surface above. The nasoturbinal is distinct from the meso-ethmoid. The second ectoturbinal is of the same size as the first, but more distinctly biconvolute at the base. The third is the longest of the ectoturbinal series, and reaches the centre of the ectoturbinal space. Three additional plates, rudimental in character, are seen on the lateral aspect of the section. The endoturbinals are also nine in number, four of them only reaching the median surface. They are much more convolute than in the ectoturbinals, and present a number of secondary folia.

The sphenoturbinal is seen distinctly united to the meso-ethmoid.

In the two-toed sloth,† *Cholœpus didactylus* (Plate III. figs. 5, 6), the cribriform plate is without angulation, as seen in the skull of the young of this species, and the entire surface which answers to that for endoturbinals is marked by four plates and associated foramina. The plates are all united anteriorly into a single transverse lamina. The posterior non-perforate space equals in longitudinal diameter one third of the area of the cribriform plate. The septoturbinal space is scarcely raised above the plane of the turbinal spaces. The crista galli answers in

* For purposes of comparison, the encranial surface of the ethmoid bone of the hog is figured (Plate III. fig. 4), but not described.

† For purposes of comparison, the encranial and the nasal surfaces of *Bradypus* are presented in figs. 1 and 2 of Plate IV., but not here described.

position to the anterior two-thirds of the same. No separate arrangement for ectoturbinals appears to exist. On the nasal surface the endoturbinals are, with the exception of the first, without lobes, and the nasoturbinal and the ectoturbinals are absent. The sphenoturbinal is united to the septum by three distinct laminæ.

In the *cat* * the nasal surfaces are much compressed medio-laterally. With the exercise of a little care, the parts can be analyzed without resorting to a transverse section. The first ectoturbinal is excessively short, and presents biconvolute folia directed upward. The second, third, and fourth ectoturbinals are slight, and are biconvolute their entire length. The plates and the convexities of the convolutions are distinctly visible on the lateral surface of the ethmoturbinal mass. The nasoturbinal is biconvolute, the median convolution being the larger anteriorly. The lobule of this turbinal is in height equal to one half the length of the nasoturbinal, and is crescentic in outline. The nasoturbinal and all the ectoturbinals are united anteriorly by a transverse lamina.

The endoturbinal plates are five in number. The first is the largest of the series. It is obscurely convolute, while the lobule is as long as the plate. It is obliquely placed from above downward, and before backward, lying in front of the second and third endoturbinals, and composed of a number of closely-set convolutions. It is the anterior division of Strauss-Durckheim. The second plate also possesses a distinct foliated lobe. The second and third plates are united on the lateral surface by a common lamina. The third plate is small, concealed from the median surface, without lobes, and partly concealed on the lateral surface by the above-named lamina. The fourth plate closely resembles the second. Its lobule is nearly the length of the plate. The fifth is without a lobe, and convolute medianly, the convex surface of this convolution appearing for its entire length on the free median surface of the ethmoturbinal mass.

In the seal, *Phoca vitulina* (Plate IV. figs. 3–5), the encranial surface presents a narrow septoturbinal surface. It lies on the same plane with that of the turbinal surfaces, extends over less than one third the width of the encranial surface, and terminates anteriorly by an enormous foramen. The rounded surface answering to the ectoturbinal space is bordered by an elliptical row of foramina. The ridges for the endoturbinals are inconspicuous and short, not extending, even for the first endoturbinal, more than one third of the diameter of the cribriform plate.

* Elaborate figures of the ethmoid of the *cat* are contained in the work of Strauss-Durckheim, *loc. cit.*

The crista galli is robust, and extends the entire length of the cribriform. The non-perforate space is one third as long as the cribriform, thus presenting a striking contrast with the same plate of the other Carnivora mentioned in this paper. It is concealed in part by the frontal bone in articulation of the bone with the cranium, but in the disarticulated bone it is convex or rounded in outline and nearly equal to the ectoturbinal surface in diameter. From it the ectoturbinal plates in part arise. These last-named plates, with their accompanying convolutions, are well seen on the lateral surface.

As in the *dog*, the *cat*, the *otter*, and other carnivores, the nasoturbinal, as in the *seal* in part, arises from the meso-ethmoid. It is held to the meso-ethmoid one half the length of the latter, at its upper margin. The union does not interfere with free access of air to the olfactory plates.

Huxley makes a statement, in his "Anatomy of the Vertebrated Animals," to the effect that the ethmoturbinals in the seal are small and flattened, and that the latter are *anchylosed with the vomer on each side*. In a single specimen examined I did not find this to be the case. (See Plate IV. fig. 3. The position of the arrow indicates the septoturbinal space.) It is true that the mass is, on the whole, flattened; but the frontal portion of the mass is more than usually well developed, and at no point did anchylosis exist. The remarkably thickened transverse lamina was probably in this statement mistaken for an exceptional layer of union.

In the star-nosed mole, *Condylura cristata*, the ectoturbinals advance forward as far as the anterior end of the transverse lamina. The nasoturbinal extends as far as the third premolar. The first endoturbinal reaches to the last premolar; the second and third are of nearly equal size; all the endoturbinals presenting uniformly broad contiguous median surfaces, the first and third not connected below the cribriform plate. In transverse section the ectoturbinals are seen to be four in number, the last being the largest. It would here seem that the last is the one retained in the Cheiroptera.

The Ethmoid Bone in the Cheiroptera.*

Enough has been said, I trust, of the general plan of arrangement of the several parts in the ethmoid bone of mammals, to serve as an introduction to the description of the bone in the Cheiroptera. It was, indeed, in attempting to describe the bone as found in the bats that the necessity of a revision of the subject became evident. It is not to be

* The crania furnishing the basis of this study were, with few exceptions, furnished by the Museum of Comparative Zoölogy.

inferred from this statement that the ethmoid bone in the bats differs in any essential feature from the bone as above described. In the more generalized forms, as the Pteropines and in most of the Phyllostomines, the ethmoid, while simple in construction, is in general appearance much the same as in other mammals. But in the more specialized genera, the details are so strongly contrasted with those of the mammalian type, (presenting a number of characters, which it is thought may be of value in classification,) that the special attention of the reader is invited to their consideration.

Descriptions of the Ethmoid Bone, including all its Parts.

Pteropus medius. — The encranial surface presents a small ectoturbinal space, which, however, is as wide as the union of the septoturbinal and endoturbinal spaces farther backward. The cribriform is thus narrowed, and without conspicuous ridges or other markings than the median and lateral rows of foramina. The non-perforate surface is a mere narrow rim.

The ethmoturbinal mass is much compressed laterally, and composed of a single ectoturbinal and a series of four endoturbinal plates, which are united anteriorly and laterally. The tendency for the endoturbinal plates to form parts of one functional surface recalls the disposition of the parts in the Quadrumana. The opening above the endoturbinal series is distinctly median. The first plate lateral to this opening would be the nasoturbinal, which here does not appear to be different from the usual disposition of an ectoturbinal, and I have concluded so to name it.

The ectoturbinal extends as far as the plane of the anterior border of the first molar. It is higher at its origin from the cribriform plate than at its anterior free end. It is curvilinear and convolute outward. It is attached its entire length to the lateral surface of the ethmoturbinal mass, and anteriorly to the endoturbinal transverse lamina.

The endoturbinal series of plates are united by a broad transverse lamina, which anteriorly (i. e. beyond the point of its union with the vomer) is deeply concave on its free under surface, so as to cover in the maxilloturbinal.

In a profile view of the median surface of the ethmoturbinal series the vertical aspect of this concave surface is distinctly seen, and closely resembles a lobe; but it is not traceable to any one olfactory plate. The transverse lamina is traceable backward to the anterior ends of all the olfactory plates, including the ectoturbinal. The lower anterior half of the median surface of the plate is emarginate. The anterior

end of the lamina reaches as far as the canine tooth. Of the endoturbinal plates themselves it may be said that the first endoturbinal plate is nearly simple, and reaches the transverse lamina at the plane of the anterior border of the first molar. The second endoturbinal plate arises in common with the preceding, and ends at the same point. It is biconvolute. The third plate reaches as far as a point between the first and second molars. It is convolute, but permits a small portion of the plate to be seen anteriorly.

Cynopterus. — The general plan of the plates is the same as in *Pteropus*. The median vertical aspect of the concavity of the transverse lamina is one fourth the length of the second endoturbinal plate. The anterior margin is concave.

Epomophorus gambianus (Plate V. fig. 1). — The general plan of the plates as in *Pteropus*. The produced end of the transverse lamina reaches the plane of the anterior edge of the second premolar.

Cynopterus. — The general plan of the plates as in *Pteropus*. The anterior margin of the median vertical aspect of the transverse lamina is straight (that is, not concave), and less oblique than in *Pteropus*.

Phyllorhina tridens (Plate VI. fig. 5). — The olfactory plates two in number. They are apparently the first and second endoturbinals. Each plate ends anteriorly in a clavate median process or lobe. The two are separate from each other, and nearly vertical in position. The encranial surface is of extreme simplicity.

Rhinolophus ferro-equinum (Plate VI. fig. 4). — The first ectoturbinal arched, long, reaching as far as the plane of the anterior border of the first molar. The first and second endoturbinals are horizontal, simple, not contiguous. They are without lobes, and are non-convolute. They do not advance beyond the vomerine portion of the transverse lamina. The encranial surface is slightly inflated over the cribriform plate. The ectoturbinal space is absent. The non-perforate space is scarcely at all raised.

Megaderma frons (Plate VI. fig. 2). — The ectoturbinal absent. The endoturbinals two in number, as in *Phyllorhina* and *Rhinolophus*. Both of these possess small swollen lobes, but are both confined within the limits of the vomerine portion of the transverse lamina. The lobes, as they appear on the median surface, are nearly vertical. Projecting in advance of the plates as far as the level of the last premolar is a lobule, which may be said to represent the produced transverse lamina, although in this genus it more closely resembles a septum defining the outer wall of the nasal chamber. The encranial surfaces were not examined.

Megaderma spasma (Plate VI. fig. 1). — The ectoturbinal a minute tubercle, lying above and to outer side of first endoturbinal. The ethmoturbinals four in number. The first endoturbinal is separated by a short interval from the remaining two. It is but slightly lobulated, extends as far as the level of the anterior border of the second molar, and is obliquely placed from above downward and from behind forward. The second and third endoturbinals are parallel, nearly contiguous, the second scarcely exceeding the third in length. The first is lobed for one third its length.

Nycteris thebaica (Plate VI. fig. 3). — The plates are three in number, one ectoturbinal and two endoturbinal. The first of these answers in position to the nasoturbinal, since it bounds posteriorly the opening leading outward from the nasal chamber. Its frontal surface is furnished with a clavate swelling, which is slightly projected as a small lobe. The first and second endoturbinals are smaller than the nasoturbinal, and are so arranged as to permit the second to conceal the third. The latter is, indeed, the only one of the two seen in profile, the former lying between it and the nasoturbinal. The first endoturbinal is slender pedunculated, and bears a small bifid lobule. The second endoturbinal is almost as stout as the nasoturbinal, and its lobule projects forward for a distance equalling one half of the plate itself. The lobe is obscurely clavate.

In the Vespertilionidæ the arrangement of the plates is more simple than in the Pteropidæ, but more complex than in *Rhinolophus* and the allied genera.

Vesperus. — The openings of the septoturbinal space are confined to a large foramen placed just in advance of the non-perforate space. Near to the septum, at the anterior portion of the space, is seen a group of foramina advancing well to the front. Directly opposite the beginning of this series to the lateral side is the group of foramina for the first endoturbinal plate, while in front of the latter lie the two foramina for the single ectoturbinal plate. The arrangement is the same in *Vespertugo*.

Seen from the nasal aspect in *Vesperus noctula*, the ectoturbinal is two thirds the length of the first endoturbinal. It is thickened above and convolute laterally at the summit. The lateral surface is concave. The entire plate rests on the concave lateral surface of the first endoturbinal. The last-named plate is very broad above, and expands laterally and in front of the ectoturbinal. It is narrower at the base than at the tip, where it is prolonged slightly along the median border into a slen-

der process. The lateral border of the portion in advance of the transverse lamina extends as far as the anterior edge of the second premolar. It is concave to receive the convex maxilloturbinal. The second endoturbinal is slightly narrower behind than in front. It is twice the size of the third endoturbinal, which is subrounded.

Vesperus fuscus. — The ectoturbinal is as in *V. noctula*, with the exception that it is deflected a little more outward. The first endoturbinal is acuminate, with a uniformly sloping border. On the median surface the plate is not visible below the second and third plates. The second plate is as in *V. noctula*. The third is longer than wide.

Scotophilus Temmincti. — The ectoturbinal is compressed medio-laterally, without lateral concavity, and is deflected slightly outward. It is a little more than one half the length of the first endoturbinal. The latter plate is much as in *V. noctula*. Its lateral border extends a short distance beyond the ectoturbinal. The end of the free portion is a narrow point, and lies at the level of the premolar. The median surface bears a general resemblance to the same part in *V. noctula*.

Vespertilio (Plate VII. fig. 6). — The encranial surface in all essential features as in *Vesperus*. The single ectoturbinal one third the length of the first endoturbinal plate. As seen from above, the ectoturbinal is lodged in a concavity in the lateral surface of the preceding plate. The first endoturbinal is produced as far as the first premolar. The plate is of a pyriform figure as seen from above, and presents a truncate apex. The portion in advance of the transverse lamina is deeply concave below, and overlies the maxilloturbinal. The second endoturbinal is of a triangular figure, with a rounded apex. It appears to be lodged, when the parts are viewed superficially, on the median surface of the endoturbinal series. The third endoturbinal is the smallest of the three, and is continuous with the upper portion of the first endoturbinal.

All the preceding genera of the Vespertilionidæ, as contrasted with the genus next to be mentioned, have the first and third endoturbinal plates united above the second plate.

Atalapha. — In *A. noveboracensis* the encranial surface presents the septoturbinal foramina placed in a row along the anterior half of the space of the same name. The openings of the ectoturbinal surface are in a direct line with the foregoing, and both are depressed below the general surface. The foramen for the first endoturbinal is seen lying at the bottom of the conspicuous depression near the crista galli. The foramina are everywhere at the sides of the encranial surface. Seen from the nasal aspect the ectoturbinal seems to be nearly the length of

the first endoturbinal, and is compressed medio-laterally. It is slightly convolute outward at its base, and concave on its lateral surface. The first endoturbinal is abruptly acuminate anteriorly, and straight on its median, lateral, and under free surfaces, the last named being concave inferiorly. The second endoturbinal plate is oblique, and slightly inflated at its anterior end. Its lower border forms the inferior edge of the median series of plates. The third endoturbinal is triangular in shape, and is one half the size of the preceding.

In *A. cinereus* the general plan resembles that of the foregoing species. The parts are, however, of greater height, the interval between the first and second endoturbinals being wider. The second endoturbinal is relatively larger, and curved outward. This arrangement causes the plate to present a concave surface outward, which receives the swollen lower border of the third plate. The median aspect of the first endoturbinal is straight; but the lateral surface is deflected outward, and is impressed on its entire surface by the ectoturbinal which rests upon it, leaving only a raised rim of the endoturbinal round its anterior half. The median surface of the produced portion of the first endoturbinal is nearly as high as it is long. The concave under surface embraces securely the maxilloturbinal.

Nyctiecjus crepuscularis. — In this genus the encranial surface is about one third the area of the entire region, the cribriform plate marked as follows: first, a single opening is seen on the sphenoturbinal surface; second, two openings on the ectoturbinal surface; third, a relatively large depression on the endoturbinal, containing two openings, well to the lateral aspect, for the first endoturbinal plate.

The nasal surface exhibits a single ectoturbinal plate. It is a little less than one half the length of the first endoturbinal, is directed almost vertically downward, the swollen upper border looking outward. The lateral surface is concave, deflected outward as far as the tip of the first endoturbinal. It is slightly concave above. The free portion is acuminate, reaching as far as the level of the canine tooth. The second plate is as in *V. fuscus*, but not so much narrowed at the base. The third is a mere rounded nodule.

Lasionycteris noctivagans. — The septoturbinal space extends a little in advance of the septal line. There is but a single opening for the ectoturbinal. The main plate is marked by a relatively small opening, behind which extends a row of three small foramina. The non-perforate space is as in the preceding forms. On the nasal surface the endoturbinal series is inflated, and does not exhibit the lateral concavity seen in other

Vespertilionidæ. It is directed downward and forward. The first endoturbinal is as in *V. fuscus*. It reaches a point as far as the canine tooth, is slightly depressed above, and presents a uniformly sloping surface laterally. Its lower edge forms the lower border of the median surface. The second endoturbinal is of uniform width, longer than high, and equal in length to the free portion of the first endoturbinal. The third endoturbinal is smaller than the preceding.

Antrozous pallidus. — The ethmoid bone in this genus closely resembles that of other Vespertilionidæ. The ectoturbinal is compressed medio-laterally.

Mollosus obscurus. — The ectoturbinal is biconvolute, slightly acuminate in front, and subequal in length to the mesoturbinal. The endoturbinal is somewhat broader in front than behind, straight on its median surface, concave on its lateral surface to receive in a measure the ectoturbinal. It is apparently without an olfactory plate, which being understood to be present the entire endoturbinal forms a summit thereto with two convolutions which make up the median and lateral surfaces respectively. The concavity thus opening downward receives in part the maxilloturbinal. The second endoturbinal is absent. The third and fourth closely resemble the same plates in the Phyllostomididæ, and do not demand any special description. The transverse lamina is apparently absent.

M. perotis. — The ectoturbinal is compressed from side to side, and is one half the length of the first endoturbinal. The first endoturbinal is acuminate as it is seen from the median surface, the portion projecting in advance of the third endoturbinal being slightly convex inferiorly. The third endoturbinal is received in a depression on the lateral surface of the first, the second being absent. It in turn receives the fourth. Both these turbinals as seen *in situ* are longer than wide.

Natalus stramineus. — The ectoturbinal is absent. The second is slender and acuminate, the convolutions uniting inferiorly at the anterior two-thirds. The lower border of the free part is straight. The third endoturbinal is globose, and one third the length of free portion of the preceding. The fourth is exceedingly minute, being about one third the length of the third. It is somewhat rounded in form.

Taphozous (Plate VII. figs. 2, 4). — The ectoturbinal somewhat broader than the first endoturbinal, but of the same length. The transverse lamina deeply concave, completely concealing the small maxilloturbinal. The under portion of the free portion of the first endoturbinal is traceable as far back as the end of the endoturbinal series. The median aspect of the concavity not projected, as in most genera, but appears as a

rounded convexity of equal width with the exposed portions of the endoturbinals. The second endoturbinal appears as a nodule between the transverse lamina and the second endoturbinal; the third and fourth much as in other genera, the lower border of the third plate being visible from the lower edge of the series.

Rhynconycteris naso. — The ectoturbinal absent. The remaining three endoturbinals closely resemble one another. The first projects in advance beyond the third no more than the third projects beyond the fifth. The free portion of the first small, yet reaches the level of the anterior of the second premolar. The plates on the median surface while contiguous leave exposed a larger surface than is the case in any other genus of the Molossi.

Noctilio leporinus (Plate VII. fig. 5). — The ectoturbinal inflated nearly twice the thickness of the first endoturbinal, and nearly equalling it in length. The median aspect of ethmoturbinal closely resembling Molossus. The free portion of each plate of about equal width. The nasoturbinal of great width anteriorly, and almost entirely concealing the maxilloturbinal.

Mormops megaphylla. — The encranial surface presents the following features. The single ectoturbinal foramen is small. That for the first endoturbinal is conspicuous. The extent of the non-perforate space appears to be enormous as compared with the same space in other genera. The ectoturbinal is a mere rounded point at the base of the first endoturbinal. The endoturbinal series closely resembles the same in the Vespertilionidæ. The first endoturbinal is without the lobe present in *Chilonycteris*. Its under surface is concave at the free produced portion, and conceals the unusually long maxilloturbinal. The second ethmoturbinal is very slender and oblique. It is continuous above with the first thus differing from the arrangements seen in Vespertilionidæ. The third plate is obscure, if not absent. It is apparently continuous with the crista galli.

Chilonycteris rubiginosa. — The first ectoturbinal subglobose, one fourth the length of the first endoturbinal. The free projecting portion of the first endoturbinal is deeply concave beneath, and completely covers in the maxilloturbinal, as in the Vespertilionidæ. It reaches as far as the first premolar. This plate bears upon its summit a lobule, as in the Phyllostomididæ. The second and third endoturbinals are simple, non-revolute, nearly vertical, the third being the broader.

Desmodus rufus (Plate VII. fig. 1). — The ectoturbinal is inflated, and nearly the length of the first endoturbinal. The first endoturbinal is

compressed, and reaches the plane of the anterior border of the single molar. A lobule in the position of the basal convolution of other Phyllostomines lies between the first and the third plates, and resembles in general appearance a separate endoturbinal. The second endoturbinal is small and concealed. The third and fourth plates are in general appearance much as in other Phyllostomines. The lobes of the first and third endoturbinals are conspicuous.

Carollia brevicauda (Plate V. figs. 3, 5). — The first ectoturbinal is inflated, with no trace of the concavity marking the plate in the Vespertilionidæ. It is two thirds the length of the first endoturbinal. The last-named plate is narrowed anteriorly, but not acuminate, since the tip is truncate. Its lower border is concave. The lobule at the summit of the plate is broader in front than behind, and equals the free portion in length. The third plate is concealed. The fourth is of the same size and shape as the foregoing. The fifth is triangular in form, open beneath, and presents the appearance of having a large lateral convolution equal in length with the main plate. The maxilloturbinal is rudimentary and free from the ethmoturbinal.

Lonchoglossa. — The general plan in this genus is as in other Phyllostomines. The ectoturbinal is minute, compressed, not more than one half the length of the first endoturbinal. The latter is thin, straight, with a long falciform lobe, which is concave inferiorly. The basal lobule is well developed, and lies at the lower border of the median surface of the ethmoturbinal. The remaining endoturbinals as in other Phyllostomines, but less obliquely inclined.

Phyllostoma hastatum (Plate V. fig. 2). — The foramina of the septoturbinal and the ectoturbinal surfaces on the encranial aspect form a continuous arch. The depression for the main plate is large, and the space behind it is occupied by numerous openings arranged without apparent order.

Schizostoma. — The ectoturbinal is moderately inflated, but less so proportionally than in *Dermanura*. The narrow and acuminate first endoturbinal projects about one third of the length of the ectoturbinal. Its lobule is inconspicuous. The second endoturbinal is concealed, and presents a slightly inflated upper border. The third plate possesses a large anterior lobule, which is convex forward. The parts are contiguous upon the median surface.

Macrotus Waterhousii. — The ectoturbinal is small, a little less than one half the length of the first endoturbinal. Its upper border is horizontal, and its lower concave. The extreme tip of the lobule extends as

far as the anterior border of the first molar. The second plate is concealed, and the third and fourth are arranged much as in *Vampyrops*, which this form in great part resembles. The lobule on the first endoturbinal is small, but readily discernible. The plates below their inflated summits are not clearly seen. The parts on the median surface are contiguous.

Vampyrops. — The ectoturbinal extends the entire length of the inner wall of the orbit, and is inflated. The first endoturbinal is concealed between the last named and the second endoturbinal. It is a simple inflated plate, without convolutions. It is in intimate association with the region of the second plate, with which it may be confounded. If the first endoturbinal plate be counted as a lobule upon the base of the second, the series will lack the number five which all other genera of this group possess. Assuming, therefore, that the concealed plate is the true second endoturbinal, the one below it becomes the third. The last-named third plate is the largest of the series, and resembles the second of the *Pteroderma* related forms. It is broad, non-convolute, and ends in a narrow tongue that reaches a point as far forward as the anterior border of the first molar tooth. The fourth endoturbinal is a nearly simple plate, having a thickened free upper border. Its free surface is entirely median, and almost linear. The fifth endoturbinal is exposed on the median surface for its entire extent; its anterior border is thickened, and convolute upwards. The frontal section of the ethmoturbinal presents the ectoturbinal and the first endoturbinal in close juxtaposition and assuming a medio-lateral relation, while the remaining plates are arranged nearly at right angles to them. There appear to be no plates comparable to the sphenoturbinals.

Pteroderma (Plate V. fig. 6). — The ectoturbinal of a triangular form, whose base is forward and advances as far as the ends of the olfactory plates of the endoturbinals minus the lobules, and nearly to the hinder border of the orifice of the maxillary sinus.

The first endoturbinal is convolute laterally, and possesses an acuminate lobe directed forward that equals the plate itself in length. The free end of the olfactory plate is distinctly seen beneath the level of the lobe. Lying at the level of the lobe just described, behind the free portion of the plate, is a small nodule, which may receive the name of the *posterior lobe*, as opposed to the preceding, which is as compared to this an anterior lobe. The second endoturbinal plate is free inferiorly, but is biconvolute above for the greater part of its length. The last-named portions are concealed by the lobes of the adjacent plates. The third

endoturbinal plate is free beneath, and possesses a broad fleshy lobe directed forward. The fourth plate, unlike the preceding, is not free at its base beneath, and is the smallest of the series. It presents a concave border in front, and is furnished with a fleshy lobe which is directed backward. The surfaces of all the olfactory plates are separated by appreciable intervals.

Artibeus (Plate V. figs. 4, 6). — The parts in this genus closely resemble those of *Pteroderma*. The ectoturbinal is exceeding slender, and is furnished with a fleshy summit, which is convolute outward. Its upper portion alone is seen from the median surface. The first endoturbinal is free below, but fleshy above. It is produced forward one half its length beyond the end of the ectoturbinal in the form of a lobule, is acuminate, and possesses as in *Dermanura* a small posterior lobe. The second endoturbinal is concealed by the third. When the latter is pressed aside at its upper part the small biconvolute plate of the second plate is seen in position. The third endoturbinal possesses a large lobule, which lies upon the median surface. The lobule is subrounded in form, completely occupying the upper edge of the plate, so that it appears to arise from the cribriform plate by a pedicle. The fourth endoturbinal presents an exposed plate on the median surface. It is beneath the convex non-perforate space, and yields a single large convolution, which is turned outward. Although this plate lies back of the cribriform plate, the absence of any connection between it and the vomer would seem to show that the arrangement met with in many mammals is departed from.

Dermanura. — In this genus the ectoturbinal is inflated, and is projected beyond the first endoturbinal one half its length. The first endoturbinal is concave outward, is without a lobule, and in a measure embraces the last-named plate. The remaining plates are arranged as in *Pteroderma*. On the encranial surface the depression for the main plate is without associated foramina, but in their stead three openings are seen, ranged transversely. The ectoturbinal opening is single.

The Physiological Anatomy of the Olfactory Sense in the Mammalia.

The olfactory organ in the mammalia is an appendage to the respiratory tract. It depends upon the direct contact of the odoriferous particle upon the specific cell fixed upon the olfactory surface, and united with a terminal filament of an olfactory nerve. The olfactory plates upon which the cells lie are composed of two sets, an ectoturbinal and

an endoturbinal, the space between them being defined on the median aspect by the nasoturbinal. In advance and beneath these plates, as well as being more or less embraced by the endoturbinals, the maxilloturbinal lies.* This bone acts as a sieve to warm the current of air entering the olfactory region, and to exclude extraneous particles. The particles which pass through the upper half of the maxilloturbinal pass directly to the ectoturbinals and the plates of the endoturbinals for the distance from their lateral attachments to the primary terminal convolutions or endings. The current passing through the lower half of the maxilloturbinal is received within the space below the level of the ethmoturbinal, and is chiefly respiratory. A large opening exists between the nasal chamber and the superior maxillary sinus, partly within which the ectoturbinal plates lie. The lower current may be deflected in part laterally through this opening or drawn upward between the lobes of the endoturbinal plates. Direct contact of the inspiratory currents through the space between the maxilloturbinal and the septum must be inconsiderable, by reason of the close relation, if not contact, existing between these parts. A small passage between the nasoturbinal and the septum would permit some to pass. It will be seen that all the currents above indicated are directed immediately inward, or inward and upward. In these directions no continuity with the air-passage exists. The currents in time must impinge upon the sides and roof of the nasal chamber above the level of the transverse lamina, and lie against the cribriform plate. Within this restricted area the currents may be assumed to cease, and their odor-bearing particles to fall gently upon the olfactory surfaces. This condition of rest doubtless goes on while ordinary respiration continues. So it is conceivable for a gentle respiratory current to be passing in and out along the lower portion of the nasal chamber, while the air is at rest unloading itself of its odoriferous particles above the transverse lamina. When the air is sniffed, the invitation for its ascent into the olfactory chambers is marked, — an act probably accompanied by partial elevation of the soft palate, by which means the respiratory current through the nose is suspended, and the air compelled to ascend to the olfactory level. The transverse lamina, therefore, has great functional significance. The parts contained above this

* The maxilloturbinal is continuous forward through the means of a well-defined crest into the snout, where it ends in the prominent swelling at the upper lateral border. Near its end it is concave outward, the concavity receiving a little crest-like fold on the outer side of the snout. The above description applies to the parts as seen in *V. noctula*, but is probably true of all mammals.

lamina would appear to have the most strongly localized olfactory significance, and the projected parts or lobes to be in part protectors of the maxilloturbinals, or highly specialized portions of the olfactory apparatus, in animals remarkably endowed with the sense of smell.*

Conclusions.

From the foregoing statements it is evident that the ethmoid bone varies greatly in its details in the Mammalia. While these variations may not have yielded any clews to relationship of genera in addition to those already entertained, they may nevertheless be said to present new evidence by which old claims can be strengthened. It has been seen that generalized forms, such as *Sus*, *Equus*, or *Dicotyles*, are related to more specialized forms, such as *Bos* or *Ovis*, not only by the characters yielded by the foot, the teeth, and the placenta, but by the ethmoturbinal bones as well. In like manner, in a generalized genus of the Carnivora, as *Ursus* or *Procyon*, the ethmoturbinal bones possess a less degree of specialization than in *Felix* in one direction, and in *Phoca* in another. If the testimony in confirmation of such relations of these genera were lost, it could be restated from the data obtainable from a study of the ethmoidal plates. — In the *bats* a plan similar to the one existing in the majority of the mammals is recognized in the Pteropidæ and Phyllostomididæ (groups already known to be generalized), but which is strangely departed from in highly specialized forms, as the Megadermatidæ and the Rhinolophidæ, and in a widely different way in the Vespertilionidæ. —It has been found that in many of the Cheiroptera, generic and even specific characters can be found in the ethmoid bone; and, on the whole, it is temperate to affirm that a comprehensive account of any species of *bat* would be imperfect which omitted an account of this bone. It is probable that a similar statement might with propriety be made for all mammals. Certainly it may be said that, in the study of those genera

* The relation borne by the ectoturbinals to the frontal sinus, by the sphenoturbinals to the sphenoidal sinuses, and by the passages of access to the lateral part of the ethmoturbinals to the maxillary sinuses, suggests the probability that the primary signification of these chambers is to accommodate the olfactory plates ; and that in the human subject, where they are empty and not held subservient to the sense of smelling, the original conception has been lost, owing to the stunted condition of the olfactory apparatus. Until elaborate studies of the development of the mammalian head are instituted with the object of confirming such a suggestion, but little can be said about it in this connection. It must be remarked that the labors of Kitchen Parker (*loc. cit.*) have not led to any affirmative answer to such a line of inquiry.

of whose affinities the zoölogist remains in doubt, a careful examination of the ethmoid bone should be made. — Much might be said of the relation existing between the size of the olfactory bulb and the degree of development attained by the ethmoturbinal plates, — the bulbs, as has been found, being well developed in animals having large ethmoturbinals, and being small in others having small endoturbinals, — and of the mechanism of the act of smelling, and the significance, in a word, of the function of smelling in connection with habit. But any such extended discussion would be out of place in a communication planned as this has been, and would in no way strengthen the proposition which it was the original object of the paper to demonstrate.*

* I may here add, that a careful microscopic study of the cells of the olfactory plates, and a comparative study of the olfactory sense, and the tactile sense of bats as developed in the external nasal appendages, yielded at the hands of my friend, Dr. Francis X. Dercum, a negative result. The forms that were taken for study were *Phyllostoma hastatum* and *Nycteris Thebaica*.

EXPLANATION OF THE ABBREVIATIONS EMPLOYED IN DESCRIBING THE FIGURES.

m. t.	Maxilloturbinal.	*sp. t.*	Septoturbinal.
n. t.	Nasoturbinal.	*fr.*	Frontal.
tr. l.	Transverse lamina.	*op. f.*	Optic foramen.
ect. t.	Ectoturbinal.	*cr. gl.*	Crista galli.
end. t.	Endoturbinal.	*orb.sph.*	Orbitosphenoid.
ect. sp.	Ectoturbinal space.	*n. p. s.*	Non-perforate space.
end. sp.	Endoturbinal space.	*l.*	Lobule.
s. t. sp.	Septoturbinal space.	*ol. pl.*	Olfactory plate.
m. e.	Meso-ethmoid.	*orb. pl.*	Orbital plate.

EXPLANATION OF FIGURES.

PLATE I.

Fig. 1. Sagittal section of head of the dog, showing the oblique position of the encranial surface of the ethmoid bone, with the median aspect of the lateral mass of the same bone. A portion of the septum has been included in the section at the transverse lamina. The horizontal line between the asterisks represents the dividing line between the olfactory and the respiratory regions of the nasal chamber. — It is probable that some variation will be found to exist in the turbinals of the domestic dog. Natural size.

Fig. 2. Frontal section of the nasal chamber of the dog, a short distance in advance of the encranial surface. Natural size.

Fig. 3. Diagrammatic representation of the encranial surface of the dog. Natural size.

Fig. 4. Encranial surface of the otter. Natural size.

Fig. 5. Diagrammatic frontal section of the turbinals of the otter. Natural size.

PLATE II.

Fig. 1. Median surface of lateral mass of ethmoid bone of *Cebus capuccinus*. Natural size.

Fig. 2. The under surface of same. Natural size.

Fig. 3. The under surface of lateral mass of the human ethmoid bone. Natural size.

Fig. 4. The encranial surface of the ethmoid bone of the horse. The dotted line, as it extends across the surface, represents the lower limit of the plate of bone described in the text as covering in the ectoturbinal subdivision of the surface. Natural size.

Fig. 5. Frontal section, diagrammatically treated, of the turbinals of the horse. Natural size.

PLATE III.

Fig. 1. Encranial surface of the ethmoid bone of the peccary. Natural size.

Fig. 2. The isolated ridge of the first endoturbinal plate. Natural size.

Fig. 3. Frontal section of turbinals of same, made close to the encranial surface. Natural size.

Fig. 4. The encranial surface of the ethmoid bone of the hog.

Fig. 5. The under nasal surface of the ethmoid bone of the two-toed sloth (*Cholœpus didactylus*). Natural size.

Fig. 6. The encranial surface of the same. Natural size.

PLATE IV.

Fig. 1. The anterior aspect of the ethmoturbinals of the ethmoid bone of the three-toed sloth (*Bradypus tridactylus*).

Fig. 2. The encranial surface of the same.

Fig. 3. The ethmoid bone of the common seal (*Phoca vitulina*).

Fig. 4. The encranial surface of the same.

Fig. 5. The under surface of the same.

The figures are all of natural size.

PLATE V.

Fig. 1. Median sagittal section of nasal chamber of *Epomophorus gambianus*. Slightly enlarged.

Fig. 2. The same of *Phyllostoma hastatum*.

Fig. 3. The same of *Carollia brevicauda*.

Fig. 4. The same of *Artibeus* (slightly distorted).

Fig. 5. Dorsal aspect of the turbinals in *Carollia brevicauda*.

Fig. 6. The sagittal section of nasal chamber of *Pteroderma* (slightly distorted).

Fig. 7. The dorsal aspect of turbinals of *Artibeus*.

Figs. 2–7 enlarged one half.

PLATE VI.

Fig. 1. A median sagittal section of the nasal chamber of *Megaderma spasma*.

Fig. 2. The same of *Megaderma frons*.

Fig. 3. The same of *Nycteris Thebaica*.

Fig. 4. The same of *Rhinolophus ferrum-equinum*.

Fig. 5. The same of *Phyllorhina tridens*.

Figures enlarged one half.

PLATE VII.

Fig. 1. A median sagittal section of the nasal chamber of *Desmodus rufus*. Figure enlarged two thirds.

Fig. 2. The same of *Taphozous*.

Fig. 3. The dorsal aspect of the turbinals of *Vespertilio subulatus*.

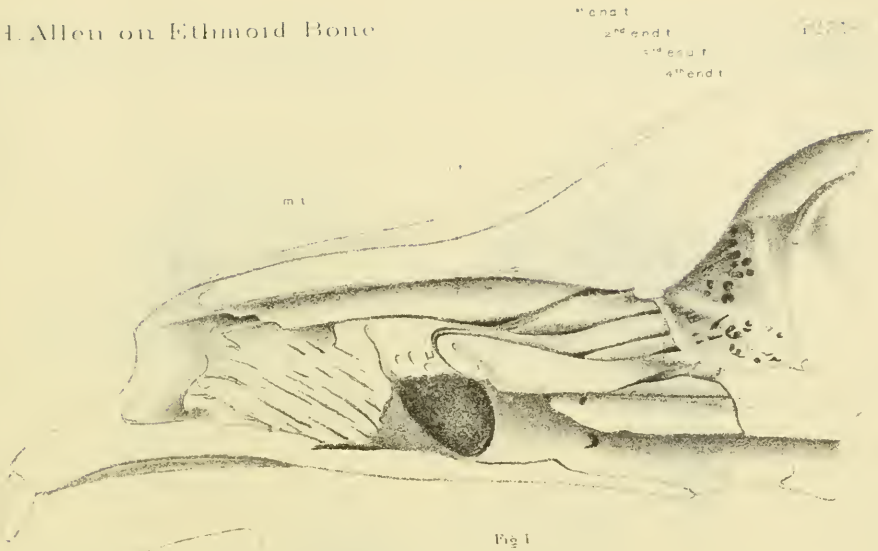
Fig. 4. The same of *Taphozous*.

Fig. 5. A median sagittal section of the nasal chamber of *Noctilio leporinus* (somewhat distorted, the nasoturbinal elevated).

Fig. 6. The same of *Vespertilio subulatus* (somewhat distorted, the first endoturbinal elevated).

Figs. 2–6 enlaged one half.

PHILADELPHIA, November 4, 1882.



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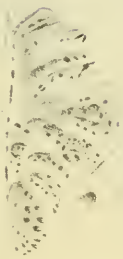

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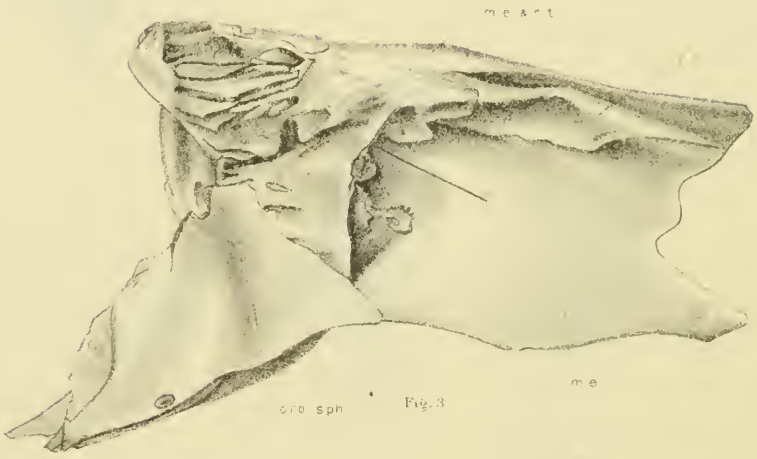

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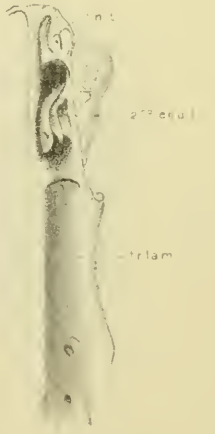

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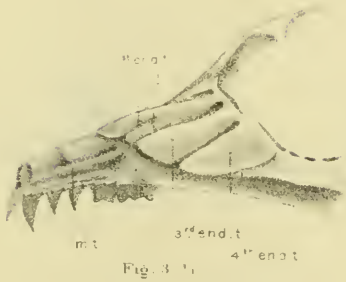

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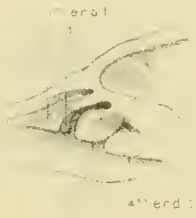

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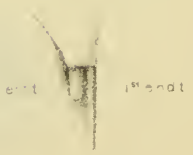

Fig. 7

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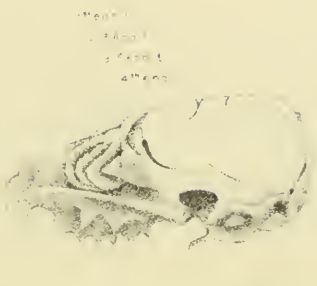

Fig. 2.

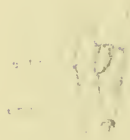

Fig.

Fig. 4.

Fig. 5.

Fig. 6.

No. 4. — *Reports on the Results of Dredging under the Supervision of* Alexander Agassiz, *in the Gulf of Mexico* (1877–78), *and in the Caribbean Sea* (1878–79), *by the U. S. Coast Survey Steamer "Blake,"* Lieut.-Commander C. D. Sigsbee, U. S. N., *and* Commander J. R. Bartlett, U. S. N., *Commanding.*

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XVIII.

The Stalked Crinoids of the Caribbean Sea. By P. Herbert Carpenter.

Owing to the lamented death of the late Sir Wyville Thomson, it has become my duty to complete the Report upon the Stalked Crinoids of the "Challenger" Expedition, which had been commenced by him. It had been arranged between Sir Wyville and Mr. Agassiz that the descriptions of the species obtained by the "Blake" in the Caribbean Sea should be incorporated in the "Challenger" report, which would thus assume the character of a Monograph of nearly all the known species of the group.* For this purpose nearly thirty plates were drawn at Edinburgh, under Sir Wyville's superintendence, but, except for a few pencil notes upon one or two of them, he has unfortunately left no manuscript behind him of any kind. It has therefore become my duty to make good this deficiency; but as the other calls upon my time leave me only a limited amount of leisure, I fear that some months must yet elapse before the publication of the final report.

The "Blake" dredgings have shown that the bathymetrical range of the Stalked Crinoids is not always so great as has been often supposed. So far as my information goes, they have only been obtained fourteen times at depths exceeding 650 fathoms, their lowest limit being the celebrated deep dredging of the "Porcupine," in 1869, where *Bathycrinus*

* *Hycrinus carpenteri* of the Norwegian North Atlantic Expedition (Nyt Mag. for Naturvid., Bd. XXIII., 1877) is undoubtedly a *Bathycrinus*, though I do not think it is identical with *B. gracilis* of the first "Porcupine" Expedition (1869). The "Vega" dredged some Stalked Crinoids off the Siberian coast, and also a large *Metacrinus* in the North Pacific, but no descriptions of them have yet been published.

gracilis was obtained in 2435 fathoms. A young *Hyocrinus* (?) was dredged by the "Challenger" in 2325 fathoms, while *Antedon* was found at 2600 and at 2900 fathoms.

So far as I am aware, no entire *Pentacrinus* was obtained by the "Blake" at a greater depth than 250 fathoms,* while six of the "Challenger" species were found within that limit; though the "Porcupine" dredged *P. wyville-thomsoni* in 1095 fathoms in 1870, and the "Challenger" got a fragment of *P. naresianus* Wy. Th. MS., in the Pacific, at 1350 fathoms, this being the deepest *Pentacrinus* yet known. *Bathycrinus*, however, ranges from 1050 to 2435 fathoms, and *Hyocrinus* from 1600 to 2325 fathoms, while *Rhizocrinus lofotensis* occurs in the Norwegian fiords at 80 fathoms, and in 175 to 955 fathoms in the Caribbean Sea. It is a great pity that we have no later knowledge of the "Australian Encrinite" on a stem 6″ long, which was obtained by Poore † at a depth of 8 fathoms in King George's Sound.

It is well known that three genera of Stalked Crinoids occur in the Caribbean Sea besides the three *Comatulæ* ‡; viz. *Pentacrinus*, *Holopus*, and *Rhizocrinus*. The last-named is represented by two species, and the first by four, viz. *P. asteria* Linn. sp., *P. mülleri* Oerst., *P. decorus* Wy. Th., and *P. blakei* n. sp. The first of these, which is the type species of the genus, seems never to have been dredged by the "Blake," except perhaps in a fragmentary state. It is mentioned, however, by Mr. Agassiz § as having been dredged off Havana in 1878, but the individuals there referred to really belong to *P. mülleri*; while the very variable form with a slender stem, which Mr. Agassiz and the late Mr. Pourtalès have spoken of as *P. mülleri*, is really the *P. decorus* of Sir Wyville Thomson. These two species have hitherto been confused with one another, and it is only since I have been able to examine the original types of them in the Copenhagen and British Museums respectively, that I have succeeded in forming clear ideas about them. The relations of the Caribbean species to one another, and to the other species of the genus, are shown in the following scheme.

* Specimens were obtained in as little as 42 fathoms, and stem fragments down to 470 fathoms.

† Ann. and Mag. Nat. Hist. (1862), Vol. IX. p. 486.

‡ *Antedon*, *Actinometra*, and *Atelecrinus*. See Bull. Mus. Comp. Zoöl., Vol. IX. No. 4.

§ Bull. Mus. Comp. Zoöl., Vol. V. No. 6, p. 56.

Genus PENTACRINUS Miller.

- The two outer radials and the first two joints beyond each axillary united by syzygies.
  - Five cirri at each node.
    - Cirri large and stout, of 35–43 joints. Rays may divide five times.
      - Usually 15–18 internodal joints. The hypozygal does not share in the cirrus-sockets. Usually more than three joints between the irregular arm divisions. Pinnule joints have forward-projecting processes. — *asteria* Linn.
      - 6–8 internodal joints. The hypozygal shares in the cirrus-sockets. Only two or three joints between the regular arm divisions. — *mulleri* Oerst.
    - 15–25 cirrus-joints. Rays only divide three times; each division of two joints united by syzygy.
      - One or two internodal joints . . . . — *maclearanus* Wy. Th.
      - 35–45 internodal joints . . . . . — *wyville-thomsoni* Jeffr.
  - Two and three cirri alternately at successive nodes. Rays divide three times; each division of two joints united by syzygy. Four internodal joints. — *alternicirra* n. sp.
- The two outer radials and the first two joints beyond them united by ligamentous articulations.
  - Ten arms. The third brachial a syzygy, with angular syzygial faces. First pinnule on the second brachial. 8–17 internodal joints. — *naresianus* Wy. Th. MS.
  - Rays may divide three times. The second free brachial a syzygy. Pinnule on first brachial.
    - 5–7 internodal joints. Nodal joints not enlarged, and the hypozygal sharing but little in the cirrus-sockets. Syzygial faces angular. — *blakei* n. sp.
    - 11 or 12 internodal joints. Nodal joints enlarged and projecting, and the hypozygal grooved to receive the cirrus-bases. Syzygial faces nearly plane. — *decorus* Wy. Th.

It will be seen from the preceding table that the Caribbean species of *Pentacrinus* are equally divided between the two groups into which the eight recent species of the genus very naturally fall. Of the remaining types, *P. wyville-thomsoni* and *P. maclearanus* both occur in the Atlantic, the former off the Portuguese coast and the latter off Pernambuco. *P. alternicirra* and *P. naresianus* were dredged by the "Challenger" off the Kermadec Islands, and also to the southeast of the Philippines, the latter species also occurring at another station in the South Pacific.

Most of the *Pentacrinidæ* obtained by the "Challenger" in the Pacific represent a new and very curious type, which Sir Wyville Thomson designated by the name of *Metacrinus* in a memorandum on one of his plates. It is readily distinguished from *Pentacrinus* by having, not three, but from four to six radials. The second of these is a syzygial joint, and bears a pinnule, as do all the following joints below the radial axillary. There are numerous other minor differences between *Metacrinus* and *Pentacrinus* which need not be considered here.

The examination of this large series of *Pentacrinidæ* fully confirms the views which I have expressed elsewhere * as to the difficulty of re-

* Journ. Linn. Soc., Vol. XV. p. 210.

taining the genus *Cainocrinus* Forbes, which has recently been resuscitated by De Loriol.* The distinguished Swiss paleontologist describes the basals of *Cainocrinus* as in contact with one another all round the calyx, so as to form a complete ring, while those of *Pentacrinus* are small and not contiguous externally, as shown in Miller's figure of *P. caput-medusæ* (*asteria* Linn.).† So far as the fossil species are concerned this certainly does appear to be a constant difference, but it is by no means so in the recent ones and in *Metacrinus*. The unique specimen of *P. maclearanus* ‡ has a closed basal ring, and so have all the examples of *P. wyville-thomsoni* that I have seen, though one or more of the basals occasionally fail to meet their fellows. But in *P. naresianus* there appears to be no constancy whatever in this respect. Some individuals of this species have a closed basal ring. But in others the basals are comparatively small and the radials are prolonged slightly downwards over the upper stem-joints. A few exhibit both conditions, some of the basals meeting their fellows, while the rest are separated by the downward projecting radials. The same variation, though in a less degree, occurs in *P. mülleri*. But it is in *P. decorus* that the most remarkable variation occurs in the size of the basals. They are sometimes smaller than those of *P. asteria*, and scarcely more conspicuous than the interradial ridges on the stem beneath them; or they may be large triangular knobs standing out prominently from the general plane of the calyx, and meeting one another laterally by their extended lower angles; or they may present any intermediate condition between these two.

The following brief descriptions of the Caribbean species of *Pentacrinus* are not to be considered as complete specific diagnoses. These will appear, together with the synonymy, in my final report.

P. asteria Linn. sp.

Stem robust, reaching 6 or 7 mm. in diameter, with 13–21 (usually 15–18) internodal joints. Cirrus-sockets widely oval, and occupy nearly the whole height of the nodal joint. The hypozygal joints rarely modified, and then very slightly so.

Cirri reaching 70 mm. in length and composed of 50 stout joints. Lowest limit of the interarticular pores from the ninth to the twelfth node. The two outer radials united by syzygy. The ray-divisions somewhat irregular. Primary arms of 2–6 (distichal) joints; secondary arms of 4–10 (palmar) joints,

* Monographie des Crinoïdes fossiles de la Suisse, (Geneva, 1877–79,) p. 111.

† A Natural History of the Crinoidea, (Bristol, 1821,) p. 51, Pl. II. fig. 9.

‡ The Atlantic, Vol. II. p. 124, fig. 31.

usually 6–8. Tertiary arms of 6–14 joints, and occasionally another division after 8 or 10 joints more. The first two joints after each axillary united by syzygy, with a pinnule on the epizygal. No other syzygies on the arms.

The joints of the large pinnules on the arm-bases have their distal edge raised into a strongly marked keel, which projects forwards over the base of the next joint. This feature recurs on all the pinnules of the arms, though it is less distinct in their middle and outer portions.

Remarks. — The above description is based on the examination which I have made of the following examples of the type: — (*a.*) Miller's original specimen from Nevis, now in the geological department of the British Museum. (*b.*) One dry specimen and another in spirit, both in the zoölogical department of the same Museum. (*c.*) One dry specimen in the Hunterian Collection of the Royal College of Surgeons. (*d.*) Two dry specimens obtained by Dr. Carpenter and Sir Wyville Thomson from Mr. Damon of Weymouth.

I have not seen either of the individuals described by Guettard * (Martinique) and Ellis † (Barbados); but judging from the figures given by these authors I have little doubt that they belong to the type which is now generally known as *P. asteria*. The specimen from Guadeloupe in the Museum of the Geological Society of London, which is mentioned by both Miller and Müller ‡ as a *P. caput-medusæ*, is really referable to Oersted's type *P. mülleri*, which is so well described in Lütken's classical memoir. § If the sixth example mentioned by Müller || be the one formerly belonging to the Natural History Society at Copenhagen, and bought in 1846 by the University Museum, it is also a *P. mülleri*.

The peculiar features of the pinnules of *P. asteria* afford an excellent specific distinction. They are well shown in Miller's figure, ¶ which represents a pinnule some little way out on the arms. In the lowest pinnules the tubercular projection at the distal end of each joint is very marked indeed; and it is recognizable, though of course less distinctly so, all along the arms; so that arm fragments of this species can be readily identified, which is more than can be said for most of the *Pentacrinidæ*.

The stem also, like the arms, has a definite character of its own, which has not always been correctly described. The nodal joint, i. e. that which is pierced by the canals lodging the cirrus-vessels, is united by syzygy to the joint below it, just as in *P. mülleri* and in all the *Pentacrinidæ;* but this lower or hypozygal joint is not grooved externally for the reception of the thick basal

* Mém. de l'Acad. Roy. des Sci. Paris, 1755 (published 1761), pp. 228–247, Pl. VIII., IX.

† Phil. Trans., 1762, Vol. LII. Part I. pp. 357–362, Tab. XIII.

‡ Abhandl. d. Berlin. Akad., 1843, p. 185.

§ Om Vestindiens Pentacriner, med nogle Bemaerkninger om Pentacriner og Söliljer i Almindelighed. Videnskab. Meddel. fra den naturhist. Foren. i Kjöbenhavn, 1864, Nr. 13–16, pp. 195–245, Tab. IV., V.

|| *Loc. cit.*

¶ *Loc. cit.*, p. 51, Pl. II. fig. 5.

portions of the cirri, as is markedly the case in *P. decorus*, and less so in *P. mülleri* and in most species of the genus. It has therefore often been said that the nodal joints of *P. asteria* are simple and low, while those of *P. mülleri* are double and thick. This is not strictly true. The nodal joints are always single and united by syzygy to those next below them, though the line of junction is frequently almost obliterated. The hypozygals may be modified to receive the cirrus-bases, as in *P. mülleri* and *P. decorus*, or they may not differ in external appearance from the other internodal joints, as in *P. asteria* and *P. wyville-thomsoni*. In this last species, however, the joint above the node is slightly excavated to receive the wide basal portions of the cirri, and this character is still more marked in the genus *Metacrinus*.

P. mülleri Oerst.

Stem generally robust, reaching 6 mm. in diameter, with 4–10 (usually 6–9) internodal joints. The cirrus-sockets, which do not reach the upper edges of the nodal joints, are variable in shape. Some are oval, and encroach but little on the hypozygal, while others are more circular and extend well down on to it.

Cirri reaching 50 mm. in length and composed of about 40 stout joints.

Lowest limit of the interarticular pores from the fourth to the eighth node.

The two outer radials united by syzygy. There are usually 6 or 8 arms on each ray in the following order, 2, 1 ; 1, 2, or 2, 1, 1 ; 1, 1, 2, the axillaries being limited to the outer arm of each successive pair. Primary arms of 2 (distichal) joints, which are united by syzygy. Secondary arms of 2–7 (palmar) joints, usually 3. The two following divisions are usually of 3 joints each, but may have 5 or 6. The first two joints after the palmar and subsequent axillaries are united by syzygy with a pinnule on the epizygal. No other syzygies on the arms.

The lower joints of the pinnules are somewhat prismatic, and the following ones laterally compressed, with sharp dorsal edges.

Examples of this type were dredged by the "Blake" at the following stations* : —

1877–78. Off Havana. 175 fathoms.
1878–79. No. 193. Off Martinique. 169 fathoms.
No. 291. Off Barbados. 200 fathoms.

Remarks.— A dry example of this species was obtained by Sir Wyville Thomson from Mr. Damon, and a spirit one was brought home from Barbados by Sir Rawson Rawson. Its stem is readily distinguished from that of *P. asteria* by the shortness of the internodes and the modification of the hypozygal joints, which, however, is far less marked than in *P. decorus*. The basals generally

* The complete list of localities for the different Crinoids dredged by the "Blake" will doubtless be drawn up by Mr. Agassiz and his assistants. I cannot, of course, do more than record the localities of the selected specimens which have been sent to Europe for study.

form a complete ring ; while the branching of the arms is much more regular than in *P. asteria*, and there are fewer joints between the successive axillaries.

P. decorus Wyv. Thomson.

Stem slender, rarely exceeding 4 mm. in diameter, with 7–16 (usually 11 or 12) internodal joints. The nodal joints are generally somewhat enlarged, with circular cirrus-sockets which do not nearly reach their upper edge, but extend well down on to the hypozygal joints.

Slender cirri composed of 25–35 joints, and reaching 28 mm. in length.

Lowest limit of the interarticular pores from the ninth to the eleventh node.

The two outer radials united by a ligamentous articulation. Ray-divisions rather irregular. Primary arms of 2–7 (distichal) joints, of which the first two are united by a ligamentous articulation, the second bearing a pinnule, while the last two often form a syzygy. Secondary arms of 1–9 (palmar) joints, which are very variable in their character. The second free brachial is usually a syzygial joint. The next syzygy from the eighth to the thirtieth brachial, after which an interval of 5–11 joints between successive syzygies.

A pinnule on the first joint after the last axillary. Pinnule joints laterally compressed, those at the base of the lower pinnules being rather broad, but the following ones are elongated.

Examples of this type were dredged by the "Blake" at the following stations : —

1877–78. Off Havana. 175 and 177 fathoms; very abundant.
1878–79. Nos. 155 and 156. Off Montserrat. 88 fathoms.
No. 269. Off St. Vincent. 124 fathoms.

Remarks.— The distinctness of this species from *P. asteria* was first recognized by Mr. Damon of Weymouth, who procured an example of it from the seas of the outer Antilles. Its occurrence was recorded by the late Sir Wyville Thomson in a popular article on "Sea Lilies," which was published in the "Intellectual Observer" for August, 1864, but no formal description of it has since appeared. At that time Sir Wyville seems to have been unacquainted with the description of *P. mülleri* by Oersted, published six years previously, for he spoke of *P. asteria* and *P. decorus* as "the only two known living species" of Stalked Crinoids. But in the following year* he referred to *P. mülleri* as well, Lütken's memoir having appeared in the interval ; so that he evidently regarded *P. decorus* and *P. mülleri* as separate species. Later on (1872), however, he seems to have come to the conclusion that his *P. decorus* was identical with Oersted's species. For, having previously said that *P. asteria* and *P. decorus* were the only two known living species of the genus, he made nearly the same statement † concerning *P. asteria* and *P. mülleri*. He likewise repeated most

* Phil. Trans., Vol. CLV. p. 542.

† On the Crinoids of the "Porcupine" Deep-Sea Dredging Expedition, Proc. Roy. Soc. Edinb., Vol. VII. pp. 765–767 ; and "The Depths of the Sea," pp. 434–442. See also "The Atlantic," Vol. II. p. 126.

of his original description of *P. decorus* as a diagnosis of *P. mülleri*, with a reference under the latter name to the specimen which he had before him when describing *P. decorus*. He stated that the two outer radials of *P. asteria* are united by syzygy, and further added that "the arrangement of the joints and the syzygies in the cup is the same in *P. mülleri* as in *P. asteria*, only the syzygy between the second radial and the radial axillary is not so complete." This description obviously refers to a ligamentous articulation as distinguished from a true syzygy on the one hand, and from a muscular joint on the other; and it is by no means in accordance with Lütken's very positive statements * as to the presence of a syzygy between the two outer radials of *P. mülleri*. Neither does Sir Wyville's description of the nodes as occurring about every twelfth joint agree with Lütken's diagnosis, which only records 4–10 internodal joints in *P. mülleri*. As a matter of fact there are 11 or 12 internodal joints in *P. decorus*, and there is no syzygy at all between the two outer radials, but only a ligamentous articulation such as occurs in the majority of the *Neocrinoidea*, and has often been wrongly spoken of as a syzygy, though clearly distinguished from it by Müller.

Had Sir Wyville lived to work out the "Blake" collection more fully than he was able to do before his health gave way, I cannot but think that he would have returned to his original views as to the distinctness of his *P. decorus* from Oersted's *P. mülleri*. The two species have really no sort of resemblance to one another, differing in all the characters of the stem, the cirri, the calyx, and the arms.

Curiously enough, *P. decorus* appears to be the most common species of the genus in the Caribbean Sea. One of the "Blake" specimens is remarkable for the total absence of cirri along the whole of one face of the stem; while at one of the nodes two more cirri are missing, so that there are only two present instead of the usual five.

P. blakei n. sp.

Stem slender, not reaching 4 mm. in diameter with 5–7 internodal joints. Nodal joints not enlarged. The small circular cirrus-sockets do not nearly reach their upper edges, and extend but slightly downwards on to the hypozygals.

Slender cirri composed of 25 joints and barely 20 mm. long.

Lowest limit of the interarticular pores from the sixth to the tenth node.

The two outer radials united by a ligamentous articulation. Usually only 4 arms on each ray. Primary divisions of 1–4 (distichal) joints, of which the first two are united by a ligamentous articulation. If 4 distichals are present, the second bears a pinnule and the two outer ones form a syzygy. The first free brachial bears a pinnule, and the second is usually a syzygial joint, while other syzygies occur on the arms at very irregular intervals. The proximal face

* *Loc. cit.*, pp. 201, 202.

of the epizygal forms a sharp angle which projects backwards into the retreating distal face of the hypozygal.

Examples of this species were dredged by the "Blake" at the following stations : —

1878–79. No. 157. Off Montserrat. 120 fathoms.
No. 281. Off Barbados. 200 fathoms.

Remarks. — This species is at once distinguished from *P. decorus* by the shortness of the internodes of the stem and the absence of any enlargement at the nodes. The calyx is closely similar to that of the variety of *P. decorus* with small basals, but the arm-bases have a totally different appearance from those of that type, owing to the peculiar nature of the syzygy in the second brachials and in the subsequent syzygial joints. The two apposed faces are not plane as is usually the case, but the hypozygal has its distal face sharply incised, while the proximal face of the epizygal is in two planes, which make a sharp angle with one another and project backwards into the hypozygal. This peculiarity is best seen in a side view of the arm, unless the joints are separated by boiling with potash or soda. The only other species of *Pentacrinus* in which it occurs is the ten-armed *P. naresianus* from the Western Pacific. In both cases it may be traced in all the syzygies of the arms, so that small fragments of them are easily recognizable.

Both the recent species of *Rhizocrinus* occur in the Caribbean Sea. *R. lofotensis* was dredged in the Florida Straits by the late Mr. Pourtalès, a few months before the publication of M. Sars's well-known description of it; and *R. rawsoni*, first found by the "Hassler" off Barbados, was subsequently obtained by the "Blake" in 1877–78 and 1878–79.

So far as my information goes, the distribution of these two species is as follows : —

R. lofotensis.

Bibb. 1868. Off the Samboes. 237 fathoms.
Off Sand Key. 248 and 306 fathoms.
1869. Off Cojima near Havana. 450 fathoms ; and several times at lesser depths.
Blake. 1877–78. No. 29. Lat. 24° 36′ N., Long. 84° 5′ W. 955 fathoms.
No. 43. Lat. 24° 8′ N., Long. 82° 51′ W. 339 fathoms.
No. 44. Lat. 25° 33′ N., Long. 84° 35′ W. 539 fathoms.
No. 56. Off Havana. Lat 22° 9′ N., Long. 82° 21′ 30″ W. 175 fathoms.

R. rawsoni.

Hassler. 1872. Off Sandy Bay, Barbados. 100 fathoms.
Blake. 1877–78. No. 32. Lat. 23° 32′ N., Long. 88° 5′ W. 95 fathoms.
Off Havana. 175 fathoms.

Mr. Agassiz mentions in his dredging letters that he obtained a number of specimens of *Rhizocrinus* among the Windward Islands in 1878–79, and a few specimens in 1880 on the line from Cape Hatteras to St. George's Shoal; but not having seen any of them, I can say nothing as to the species which they represent.

In 1869 two examples of this genus were obtained by the "Porcupine" off Cape Clear, in 862 fathoms (No. 42), and were referred at the time to *R. lofotensis*. On comparing them, however, with some specimens of *R. rawsoni* from off Havana, I find that they really belong to this type, as I had always suspected since reading Pourtalès's description of it.* *R. rawsoni* was also dredged by the "Challenger" in 900 fathoms among the Azores. It is readily distinguished from *R. lofotensis* by its more robust appearance and elongated calyx, which is nearly always constricted at the basiradial suture, instead of widening gradually upwards, as does that of *R. lofotensis*. The first radials are much shorter relatively to their width than in *R. lofotensis*, and the epizygal of the syzygial first brachial is not markedly narrower than the hypozygal as in the latter species. The greater part of the cup is formed by the elongated basals. In the Norwegian variety of *R. lofotensis* these fuse so very completely that no sutures are usually visible on the exterior of the calyx. This led Sars † and Ludwig ‡ to suggest that the basals of the young *Rhizocrinus* undergo metamorphosis into a "rosette," as in most *Comatulæ*, though this view is not supported by the observations of Pourtalès § and myself; ‖ and the fact that the so-called "enlarged upper stem-joint" of *R. lofotensis* really consists of the anchylosed basals as originally stated by Mr. Pourtalès ¶ for the Caribbean variety is now generally recognized.** The difference in the relative proportions of the two species is seen in the following table, which also shows the sizes of the stem-joints in the examples of *R. rawsoni* that were dredged by the "Blake," "Challenger," and "Porcupine" respectively, and in Sars's largest specimens of *R. lofotensis*.

* Zoölogical Results of the "Hassler" Expedition, Ill. Cat. Mus. Comp. Zoöl., No. VIII. pp. 27–31.

† Mémoires pour servir à la Connaissance des Crinoïdes Vivants, p. 12.

‡ Morphologische Studien an Echinodermen, Band I. pp. 120–122.

§ *Loc. cit.*, p. 29.

‖ On some Points in the Anatomy of *Pentacrinus* and *Rhizocrinus*. Journ. Anat. and Phys., Vol. XII. pp. 48–53.

¶ Contributions to the Fauna of the Gulf Stream at great Depths. Bull. Mus. Comp. Zoöl., Vol. I. No. 7, pp. 128–130.

** Zittel's Handbuch der Palaeontologie. Palaeozologie, Band I. p. 393.

Expedition.	Depth.	Base. Height.	Base. Width.	Length of Stem.	Stem-Joints. No.	Stem-Joints. Length.	Stem-Joints. Width.
	fath.	mm.	mm.	mm.		mm.	mm.
Blake	175	5.5	2.50	180	68	3.50	2.25
Challenger	900	5.0	2.00	150	53	3.00	2.00
Porcupine	862	3.0	1.75	50	30	2.25	1.25
G. O. Sars	300	2.0	1.50	70	67	1.50	0.50
R. lofotensis	(maximum.)						

N. B. — Pourtalès described his largest specimen of *R. lofotensis* as having a stem nearly 130 mm. long and composed of 59 joints, the length of which averages three times their diameter.

The stem-joints of *R. rawsoni* are relatively shorter and thicker than those of *R. lofotensis*, in which the length is three times the width. In absolute size, as well as in the proportions of the basals and of the stem-points, the "Porcupine" examples of this type are the ones which approach *R. lofotensis* most nearly. They are smaller than those from the Azores, which are themselves smaller than the Caribbean specimens, a fact which is doubtless due to variations of temperature. The difference in size between the largest specimens of *R. lofotensis* found by Sars and Pourtalès respectively is likewise probably the result of the difference between the temperature of the Gulf Stream in the Florida Straits and that of the Northeast Atlantic. It is noteworthy that an elongated calyx resembling that of *R. rawsoni* is chiefly found in those individuals of *R. lofotensis* which have the arms best developed ;* so that this species probably represents a further stage in the degradation of the Apiocrinite type than is reached by *R. rawsoni*. The occurrence of the latter form in the Eastern Atlantic is of extreme interest, owing to its remarkable resemblance to *Bourgueticrinus londinensis*. This type was named by Forbes from some isolated stem-joints in the London clay ; but a well-preserved calyx has since been discovered, which is now preserved in the Natural History Museum at South Kensington.

Several species closely allied to *B. londinensis*, which occur in the Tertiary deposits of France and Italy, are referred by Zittel† and other palæontologists to the genus *Conocrinus* D'Orbigny ; e. g. *C. pyriformis* Münst. sp., *C. thorenti* D'Arch. sp., *C. cornutus* Schafh. sp., *C. suessi*

* Sars, Crinoïdes Vivants, p. 4.

† Palaeontologie, p. 392. See also Meneghini, "I Crinoidi Terziarii," Atti d. Soc. Tosc., Vol. II. pp. 11–17. Schluter, "Ueber einige Astylide Crinoiden," Zeitsch. d. deutsch geol. Gesellsch., 1878, pp. 52–55. De Loriol, "Crinoïdes fossiles de la Suisse," p. 190 ; and Paléontologie Française, "Terrain Jurassique," Tom. XI. (1882), p. 65.

Munier-Chalmas sp., and *C. seguenzai* Menegh. That they are congeneric with Forbes's species and with *Rhizocrinus* I have not the smallest doubt; and the question therefore arises whether *Conocrinus* D'Orbigny is to take precedence over *Rhizocrinus* Sars.

On this subject Prof. Zittel remarks, "Nach den Regeln der Priorität gebührt dem Namen *Conocrinus* D'Orb. die Priorität, wenn gleich die Gattungsdiagnose D'Orbigny's unvollständig und theilwise unrichtig ist."

The type on which D'Orbigny founded *Conocrinus* was the *Bourgueticrinus thorenti* of D'Archiac,. but his definition of it was so incomplete and so incorrect that, even supposing Sars had not defined *Rhizocrinus* as elaborately as he did, I should not admit *Conocrinus* as a valid genus until it had been re-defined. Lütken * remarked, in 1864, that its distinctness from *Bourgueticrinus* was still a matter of uncertainty. D'Orbigny † spoke of it as "Genre voisin des *Bourgueticrinus*, mais sans pièces basales comme les *Eugeniacrinus*"; and again, "C'est un *Bourgueticrinus* ayant la tige comprimée, mais avec une seule série de pièces basales." If he considered it as near *Bourgueticrinus* and as resembling *Eugeniacrinus*, why did he omit it altogether from the tabular scheme of the *Apiocrinidæ*, which appears on page 2 of his "Histoire Naturelle des Crinoïdes Vivans et Fossiles," and contains the names of both those genera? It would seem from his reference to the absence of any tertiary species of *Bourgueticrinus* on page 96 that he included them all in *Conocrinus*, which would belong to a different family altogether. This shows how he had misunderstood its real character and affinities, and as a matter of fact his description of it as having no basals is entirely incorrect. They are visible enough in D'Archiac's figures of *B. thorenti* (the type-species of *Conocrinus*), and in other closely allied species. Lastly, the remark that *Conocrinus* is a *Bourgueticrinus* with a compressed stem, is worthless as a generic description, when the latter genus itself is described as having a round *or compressed* stem.

The differences between the two types are of an entirely different character from those mentioned by D'Orbigny, which would be absolutely unintelligible in the absence of figures or of original specimens. I feel it only right, therefore, to ignore *Conocrinus* altogether, and to adopt Sars's well-known genus *Rhizocrinus*.

The differences between *Apiocrinus* and *Millericrinus* on the one hand, and *Bourgueticrinus* and *Rhizocrinus* on the other, have led Mons. de

* *Loc. cit.*, p. 212.

† Prodrome de Paléontologie Stratigraphique Universelle, 1850, Tom. II. p 332.

Loriol * to establish a new family *Bourgueticrinidæ*, which comprises the two genera just mentioned, together with *Bathycrinus* and *Mesocrinus*, a genus recently proposed by myself. De Loriol also includes in it *Ilycrinus* of Danielssen and Koren; but this genus is certainly identical with *Bathycrinus*, which was founded by Sir Wyville Thomson † on an immature specimen dredged by the "Porcupine" in 2435 fathoms, two hundred miles south of Cape Clear. His description ‡ of the larger species, *B. aldrichianus*, from the Southern Sea, seems not to have reached the Norwegian naturalists before the publication of their genus *Ilycrinus*, which was founded on much more developed individuals than that dredged by the "Porcupine."

Of the four genera included in De Loriol's new family, *Bourgueticrinus* and *Rhizocrinus* are the two most closely allied. The differences between them are greater than was supposed by Sars, owing to his mistake about the basals of the latter type, and may be summarized as follows: —

Bourgueticrinus. Lower stem-joints not longer than wide; while one or two at the top of the stem are much longer than those below, and help to form the "summit." Basals usually wider than high.

Rhizocrinus. Lower stem-joints usually much elongated, two or three times as long as wide. Those just below the calyx are the shortest, often being mere disks. Basals usually much longer than wide, occupying the greater part of the length of the calyx, which expands somewhat from below upwards.

The last type to be mentioned is the remarkable genus *Holopus*, about which much information will be found in a communication § by Sir Wyville Thomson to the Royal Society of Edinburgh, in 1877. Since the publication of this paper Sir Wyville made a horizontal section of the cup about two thirds of its height from the base. I was never fortunate enough to learn his own views on the subject, but the appearance of the section leads me to believe that the lower part of the cup is formed by basal plates which project inwards and upwards above the level of the outer edges of the radials, just as in *Pentacrinus*.‖

* Paléont. Franç., *loc. cit.*, p. 63.

† The Depths of the Sea, pp. 450–454, fig. 73; and Proc. Roy. Soc. Edinb., Vol. VII. pp. 772, 773.

‡ "Notice of new Living Crinoids belonging to the Apiocrinidæ," Journ. Linn. Soc. Zoölogy, Vol. XIII. pp. 48–51.

§ "On the Structure and Relations of the Genus *Holopus*," Proc. Roy. Soc. Edinb., Vol. IX. p. 409.

‖ Schlüter (*loc. cit.*, p. 51) is inclined to believe that basals are present in *Cyathidium spileccense*. Like Sir Wyville Thomson, I am unable to differentiate *Cyathidium* from *Holopus*.

Sir Wyville left it an open question whether the articular facets on the upper edge of the calyx-tube belong to the first or to the second radials. I believe myself that they are of the former nature, partly on account of their great resemblance to those of certain fossil species, and partly because the axillaries appear to me to be syzygial or double joints.

Sir Wyville has pointed out that the cup exhibits a very marked division into bivium and trivium; for "one side of the border is much thicker and considerably higher than the other side, and the three arms articulated to it are much larger than those articulated to the opposite side." In fact, the three facets of the trivium are themselves unequal, the centre one being both longer and wider than the other two, which are themselves longer and a little wider than the two facets of the bivium. This want of symmetry in the calyx is very remarkable, as it is precisely similar to that described by De Loriol * in *Eugeniacrinus mayalis*, from the *Leptæna* bed (Middle to Upper Lias) of Calvados in Normandy. The calyx of this species, formed by the five contiguous radials, tapers away downwards to a truncated extremity, which De Loriol supposes to have rested on the top stem-joint, basals being apparently absent.

But although *Eugeniacrinus mayalis* probably had a short stem, it is certainly very closely allied to *Holopus*. The calyx as well as the second and third radials are covered with scattered granules of variable size, just as in *Holopus*. The two outer radials were united by a muscular joint; but in a closely allied species, *E. deslongchampsi*, which is more symmetrical and less coarsely granular than *E. mayalis*, they are united by syzygy, just as I believe to be the case in *Holopus*. Together with the calyces and separate radials of these two species, the *Leptæna* bed contains a large number of isolated arm joints,† some of which are extraordinarily like those forming the lower part of a *Holopus* arm.

One reason why I suspect the axillaries of *Holopus* to be syzygial joints is as follows. In one individual the axillaries on the two rays of the bivium are distinctly in two parts, though the sutural lines do not extend right across them. On the three axillaries of the trivium, however, no sutural lines are visible at all; though they are just traceable in another specimen, and are fairly distinct in a young one 8 mm. high.

The condition of the very young individual which was obtained by the "Blake" at Station 22, and was figured in Volume V. No. 9 of the

* Palæontologie Française. Terrain Jurassique, Tom. XI. p. 78, Pl. VIII. figs. 1–5.

† *Loc. cit.*, Pl. XI.

"Bulletins," seems to point to the same conclusion; for the lower ring of pentagonal (or rather hexagonal) plates must surely be the second radials, and the triangular ones above them the axillaries.

A fragment of a living *Holopus* was dredged by the "Blake" in 120 fathoms, off Montserrat (No. 157). It was preserved in spirit and sent over to Sir Wyville Thomson, who asked me to cut some sections of the arms for him. The condition of the dried individuals hitherto known had led him to suspect "that the tissues are very imperfectly differentiated, almost protoplasmic. When an arm is put into boiling water it falls to pieces at once, the joints simply coming asunder, and showing no trace of muscular or other organic connection except the axial cords of the joints, which sometimes keep two joints hanging in connection for a little." The spirit specimen, however, told a different tale altogether, and the sections which I have made from it show that the soft parts of *Holopus* differ but little from those of any ordinary Crinoid. The arm-joints are articulated by means of muscles and ligaments in the usual way. The two large arm-canals, the cœliac and the subtentacular, are separated by a smaller genital canal containing the genital cord. This has exactly the same structure as that of any common *Antedon*, and the ovaries which it bears at intervals are much more like those of *Antedon eschrichti* in their histological structure than are those of many *Comatulæ*. The ambulacral groove is quite narrow in proportion to the breadth of the arm, and the ovaries extend but a very little way into the pinnules. The branches which leave the axial cords of the arms to supply the pinnules take a somewhat singular course. For they are thrown into loops in a dorsoventral direction, which are small at first, immediately beneath the arm-canals, but become much more marked at the bases of the pinnules, within which the cords still retain an undulating course.

Above the water-vessel is the usual darkly colored ambulacral epithelium, which is doubtless separated from the water-vessel by the ambulacral nerve and bloodvessel, though I have not been able to see them clearly. There are no large and imbricated reniform plates at the sides of the ambulacra, such as occur in *Rhizocrinus*, *Bathycrinus*, and *Hyocrinus*. But the tentacles are unusually large, and taper rapidly from a broad base; while the lower thick part of the shaft of each tentacle is protected by a well-developed calcareous reticulation, above which are groups of more or less closely united spicules.

Eton College, September, 1882.

List of Additional Stations of Stalked Crinoids collected by the "Blake." Prepared by J. WALTER FEWKES.

RHIZOCRINUS.

R. lofotensis SARS.

* Blake,	1877–78.	No. 35.	Lat. 23° 54′ 46″ N.†	Long. 88° 58′ W.	804 fath.
"	1878–79.	No. 238.	Off Grenadines		127 "
"	"	No. 248.	Grenada		161 "
"	"	No. 259.	Grenada		159 "
"	"	No. 274.	Barbados		209 "
"	1880.	No. 306.	Lat. 41° 32′ 50″ N.	Long. 65° 55′ W.	524 "
‡ U. S. Fish Com.	1882.	No. 1124.	S. S. E. Off Nantucket . .		640 "

R. rawsoni POURTALÈS.

Blake,	1878–79.	No. 155.	Montserrat	88 fathoms.
"	"	No. 166.	Guadeloupe	150 "
"	"	No. 177.	Dominica	118 "
"	"	No. 211.	Martinique	357 "
"	"	No. 273.	Barbados	103 "
"	"	No. 277.	Barbados	106 "
"	"	No. 290.	Barbados	73 "
"	"	No. 296.	Barbados	84 "
"	"	No. 297.	Barbados	123 "
Capt. E. Cole.			Saba Bank	200 "

PENTACRINUS.

P. asteria LINN.

* Blake,	1878–79.	No. 157.	Montserrat . . . . . 120 fathoms.
Dr. Schramm.			Guadeloupe . . . . . Depth ?

* The identifications on labels in bottle with specimens, marked in this list with an asterisk, are in Mr. Pourtalès's handwriting.

† In list of Stations, Bull. Mus. Comp. Zoöl., VI. 1, p. 9, Lat. reads 23° 52′.

‡ Verrill, American Journal, November, 1882.

P. mülleri Oersted.

Blake, 1878–79.	No. 100.	Off Morro Light	250–400	fathoms.
" "	No. 101.	Off Morro Light	175–200	"
" "	No. 157.	Montserrat	120	"
" "	No. 171.	Guadeloupe	183	"
" "	No. 218.	St. Lucia	164	"
" "	No. 269.	St. Vincent	124	"
* " "	No. 274.	Barbados	209	"
" "	No. 280.	St. Charles Lighthouse (Barbados)	221	"
" "	No. 283.	Barbados	237	"
" "	No. 295.	Barbados	180	"
" "	No. 296.	Barbados	84	"
" "	V.	Santiago de Cuba (Bartlett) . . .	288	"

P. decorus Wyville Thomson.

Blake, 1877–78.	No. 21.	Bahia Honda (Cuba)	287	fathoms.
W. Stimpson.		Cuba.		
Blake, 1877–78.		Off Havana (Sigsbee) . . .	150–200	"
" "	No. 56 or 57.	Lat. 22° 9′ 15″ N., Long. 82° 21′ W. (Sigsbee)	175	"
" 1878–79.	No. 100.	Off Morro Light	250–400	"
Capt. E. Cole.		S. side of Porto Rico	667	"
Blake, 1878–79.	No. 101.	Off Morro Light, Havana . .	175–250	"
" "	No. 156.	Plymouth, Montserrat	88	"
" "	No. 157.	Montserrat	120	"
" "	No. 233.	Milligan's Key, St. Vincent . . .	174	"
" "	No. 296.	Barbados	84	"
" "	No. 298.	Barbados	120	"
Gov. Rawson (ident. by Mr. Pourtalès as *P. mülleri*).		Barbados.	Depth ?	
Blake, 1880.		Kingston (Bartlett)	100	fathoms.

P. blakei P. H. Carpenter.

Blake, 1878–79.	No. 209.	Martinique	189	fathoms.
" "	No. 295.	Barbados	180	"

No. 5. — *Reports on the Results of Dredging under the Supervision of* Alexander Agassiz, *on the East Coast of the United States, during the Summer of* 1880, *by the U. S. Coast Survey Steamer "Blake,"* Commander J. R. Bartlett, U. S. N., Commanding.

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XIX.

Report on the Fishes. By G. Brown Goode and Tarleton H. Bean.

The specimens discussed in the following preliminary report were obtained by Mr. Agassiz in the dredge and trawl, during the summer of 1880, off the eastern coast of the United States between George's Bank and a line eastward from the vicinity of Charleston, South Carolina, between north latitude 31° 57′ to 41° 35′, and west longitude 65° 35′ to 78° 18′, at depths varying from 44 to 1632 fathoms.

Many of the same species were obtained by the United States Fish Commission in the deep waters off Newport and Wood's Holl, in 1880, 1881, and 1882, as well as by various Gloucester fishermen collecting on the fishing banks for the National Museum.

Drawings have been prepared to accompany the following descriptions, mainly from material collected by Mr. Agassiz. These are not published in connection with this preliminary report, but are retained for the illustration of a monograph of the deep-sea fishes of the Western Atlantic, which is now in an advanced state of preparation.

Allusion is frequently made in the following pages to the mutilated condition of the specimens sent to us for examination. It seems only fair to ourselves to call attention to the unsatisfactory state of the material investigated, since in some instances our most studious efforts have resulted in only partially complete descriptions. At the same time, it should be said that specimens of fishes brought up from such great depths are rarely perfect after they have been separated from the mass of mud and hard-shelled invertebrates which are usually found in

the same localities, and that the tanks containing these collections were, for want of space, packed in a part of the ship close to the boiler-room, where, much to their detriment for descriptive purposes, they were partially cooked.

The Selachians collected by the "Blake" were described by Mr. Samuel Garman in the Bulletin of the Museum of Comparative Zoölogy, Vol. VIII. No. 11. A list of the stations referred to below is given in the same serial, Vol. VIII. No. 4.

LIST OF SPECIES COLLECTED AT STATIONS 302–346.

Pleuronectidæ.

1. **Aphoristia nebulosa**, new species.
2. **Notosema dilecta**, new species and genus.
3. **Monolene sessilicauda**, GOODE.
4. **Citharichthys arctifrons**, GOODE.
5. **Glyptocephalus cynoglossus** (LINN.), GILL.

Macruridæ.

6. **Macrurus Bairdii**, GOODE & BEAN.
7. **Macrurus carminatus**, GOODE.
8. **Macrurus asper**, new species.
9. **Coryphænoides rupestris**, MÜLLER.
10. **Coryphænoides carapinus**, new species.
11. **Chalinura simula**, new species and genus.

Brotulidæ.

12. **Barathrodemus manatinus**, new species and genus.
13. **Dicrolene introniger**, new species and genus.

Gadidæ.

14. **Phycis chuss** (WALB.), GILL.
15. **Phycis tenuis** (MITCH.), DEKAY.
16. **Phycis regius** (WALB.), JOR. & GILB.
17. **Phycis Chesteri**, GOODE & BEAN.
18. **Læmonema barbatula**, new species.
19. **Haloporphyrus viola**, GOODE & BEAN.
20. **Onos cimbrius** (LINN.), GOODE & BEAN.
21. **Merlucius bilinearis** (MITCH.), GILL.

Lycodidæ.

22. **Lycodes Verrillii**, Goode & Bean.
23. **Lycodes paxilloides**, new species.
24. **Lycodonus mirabilis**, new species and new genus.
25. **Melanostigma gelatinosum**, Günther.

Triglidæ.

26. **Prionotus alatus**, new species.

Agonidæ.

27. **Peristedium miniatum**, Goode.

Cottidæ.

28. **Icelus uncinatus** (Reinh.), Kröyer.
29. **Cottunculus microps**, Collett.
30. **Cottunculus torvus**, new species, Goode.

Scorpænidæ.

31. **Setarches parmatus**, Goode.
32. **Sebastoplus dactylopterus** (De la Roche), Gill.

Carangidæ.

33. **Caranx amblyrhynchus** ?

Berycidæ.

34. **Poromitra capito**, new species and genus.

Synodontidæ.

35. **Bathysaurus Agassizii**, new species.

Alepocephalidæ.

36. **Alepocephalus Agassizii**, new species.

Halosauridæ.

37. **Halosaurus macrochir**, Günther.

Stomiatidæ.

38. **Stomias ferox**, Reinhardt.

Sternoptychidæ.

39. **Sternoptyx diaphana**, Hermann.
40. **Argyropelecus hemigymnus**, Cocco.
41. **Cyclothone lusca**, new species and genus.

Scopelidæ.

42. **Scopelus Mülleri** (Gmelin), Collett.

Microstomidæ.

43. **Hyphalonedrus chalybeius**, Goode.

Saccopharyngidæ.

44. **Saccopharynx flagellum**, Mitchill.

Synaphobranchidæ.

45. **Synaphobranchus pinnatus** (Gronow), Günther.

Muræsocidæ.

46. **Nettastoma procerum**, new species.

Nemichthyidæ.

47. **Nemichthys scolopaceus**, Richardson.

Leptocephalidæ.

48. **Leptocephalus** sp. (Perhaps larva of *Synaphobranchus*.)

Raiidæ.

49. **Raia plutonia**, Garman (new to this collection).
50. **Raia ornata**, Garman (new to this collection).

Scylliidæ.

51. **Scyllium retiferum**, Garman (new to this collection).

Myxinidæ.

52. **Myxine glutinosa**, Linné.

LIST OF STATIONS AT WHICH FISHES WERE TAKEN,

With an Enumeration of the Species identified from each Station, and the Length of the Individuals.

Station 302.

1 *Phycis* sp. Unidentifiable. Young. 61 mm.

Station 303.

25 *Macrurus Bairdii.* Young and old. 55–221 mm.
4 *Phycis Chesteri.* 155–315 mm.
1 *Haloporphyrus viola.* 332 mm.
1 *Icelus uncinatus.* 50 mm.
1 *Scopelus Mülleri.* 56+ mm.
12 *Synaphobranchus pinnatus.* Spawning. 221–393 mm.
1 *Nemichthys scolopaceus.* 590 mm.
2 empty eggs of *Raia* sp.

Station 304.

1 fish, perfectly unidentifiable, — mutilated.

Station 305.

6 *Coryphænoides carapinus.*
1 *Haloporphyrus viola.* 450 mm.

Station 306.

12 *Macrurus Bairdii.* 121–310 mm.
1 *Coryphænoides rupestris.* 804 mm.
13 *Haloporphyrus viola.* 116–375 mm.
3 *Cottunculus torvus.* 62–211 mm.
1 *Stomias ferox.* 125 mm.
1 *Nemichthys scolopaceus.* 395 mm.
1 *Myxine glutinosa.* 465 mm.

Station 308.

5 *Macrurus asper.* 178–350 mm.
4 *Coryphænoides carapinus.* 210, 230, 268, and 280 mm.
1 *Chalinura simula.* 481 mm.
5 *Haloporphyrus viola.* 253–372 mm.
1 *Halosaurus macrochir.* 680 mm.

Station 309.

13 *Macrurus Bairdii.* 55–283 mm.
1 *Macrurus asper.* 235 mm.
2 *Lycodes paxilloides.* 210–227 mm.
2 *Lycodes Verrillii.* 98–135 mm.
1 *Phycis tenuis.* 620 mm.
2 *Merlucius bilinearis.*
1 *Scopelus Mülleri.* 40 mm.
1 *Stomias ferox.* 140 mm
35 *Synaphobranchus pinnatus.* 278–440 mm.
1 *Nemichthys scolopaceus.* 530 mm.
1 *Myxine glutinosa.* 412 mm.

Station 310.

2 *Cottunculus microps.* 75–108 mm.

Station 311.

1 *Citharichthys arctifrons.* 149 mm.
1 *Phycis chuss.* 390 mm.
1 *Merlucius bilinearis.* 505 mm.
1 *Sebastoplus dactylopterus.* 45 mm.

Station 312.

12 *Macrurus Bairdii.* 240–340 mm.
2 *Haloporphyrus viola.* 225–280 mm.
1 *Lycodes paxilloides.* 247 mm.
18 *Synaphobranchus pinnatus.* 455–480 mm.

Station 313.

8 *Citharichthys arctifrons.* 18–48 mm.
4 *Notosema dilecta.* 92–114 mm.
1 *Prionotus alatus.* 137 mm.
1 *Raia* sp.
2 *Merlucius bilinearis.* Young. 17–25 mm.

Station 314.

2 *Citharichthys arctifrons.* Young. 46–57 mm.
3 *Monolene sessilicauda.* 114–147 mm.
1 *Phycis regius.* 288 mm.
4 *Peristedium miniatum.* 68–82.
3 *Raia ornata.* (Lengths not given by Garman.)

STATION 315.

2 *Læmonema barbatula.* 88–180 mm.
2 *Argyropelecus hemigymnus.* 15–22 mm.
1 larval eel (*Leptocephalus*). 175 mm.

STATION 316.

1 *Aphoristia nebulosa.* 85 mm.
1 *Sternoptyx diaphanus.* 19 mm.
2 *Macrurus Bairdii.* 65–77 mm.
3 *Læmonema barbatula.* 81–88 mm.
1 *Hyphalonedrus chalybeius.* 122 mm.
5 *Raia plutonia.* (Size not given.)

STATION 317.

1 *Macrurus Bairdii.* 185 mm.
1 *Chalinura simula.* Young. 25 mm.
1 *Raia plutonia.*

STATION 321.

6 *Macrurus carminatus.* Fragments.
3 *Phycis regius.* 221–258 mm.
3 *Læmonema barbatula.* 75–120 mm.
1 *Merlucius bilinearis.* 270 mm.
1 *Hyphalonedrus chalybeius.* 70 mm.
1 *Raia plutonia.*

STATION 323.

37 *Cyclothone lusca.* 50–64 mm.
1 *Sternoptyx diaphana.* 30 mm.

STATION 324.

20 *Cyclothone lusca.* 50–57 mm.
1 *Caranx amblyrhynchus?* 33 mm.

STATION 325.

2 *Macrurus Bairdii.* 300–356 mm.
2 *Chalinura simula.* Young??
7 *Dicrolene introniger.* 166–272 mm.
2 *Barathrodemus manatinus.* 150 mm.
1 *Haloporphyrus viola.* 295 mm.
5 *Halosaurus macrochir.* 255–465 mm.
2 *Nettastoma procerum.* 440–700 mm.
12 *Synaphobranchus pinnatus.* 360–475 mm.

Station 326.

21 *Macrurus Bairdii.* 152–280 mm.
1 *Macrurus carminatus.* 230 mm. Fragmentary.
4 *Dicrolene introniger.* 135–250 mm.
1 *Cottunculus torvus.* 96 mm.
6 *Synaphobranchus pinnatus.* 375–545 mm.

Station 327.

1 *Onos cimbrius.* Young. 72 mm.
2 *Setarches parmatus.* 51–52 mm.
1 *Peristedium minatum.* 65 mm.
5 *Hyphalonedrus chalybeius.* 52–58 mm.
1 *Myxine glutinosa.* 282 mm.

Station 328.

13 *Cyclothone lusca.* 49–59 mm.
1 *Poromitra capito.*

Station 329.

1 *Glyptocephalus cynoglossus.* Fragments.
1 *Macrurus Bairdii.* 130 mm.
2 *Lycodes Verrillii.* 90–162 mm.
3 *Scopelus Mülleri.* 52–64 mm.
4 *Synaphobranchus pinnatus.* 300–388 mm.

Station 330.

5 *Cyclothone lusca.* 17–55 mm.
1 *Nemichthys scolopaceus.* 520 mm.

Station 331.

1 *Saccopharynx flagellum.* Fragmentary.

Station 332.

2 *Glyptocephalus cynoglossus.* Young. 103 mm.
1 *Macrurus* sp. Unidentifiable, from mutilation.
1 *Macrurus Bairdii.* 92 mm.
6 *Lycodes Verrillii.* 118–147 mm.

Station 333.

5 *Phycis regius.* 168–225 mm.

Station 334.

4 *Macrurus Bairdii.* 127–348 mm.
1 *Glyptocephalus cynoglossus.* 282 mm.
1 *Melanostigma gelatinosum.* 103 mm.
3 *Scopelus Mülleri.* 38–52 mm.

STATION 335.

6 *Citharichthys arctifrons.* Young. 79–103 mm.
1 *Scyllium retiferum.* 311 mm.

STATION 336.

3 *Citharichthys arctifrons.* Young. 75–89.
7 *Phycis Chesteri.* 209–286 mm.
2 *Macrurus Bairdii.* 127–152 mm.

STATION 337.

1 *Macrurus Bairdii.* 239 mm.
1 *Haloporphyrus viola.* 300 mm.
1 *Lycodonus mirabilis.* 112+ mm.
2 *Synaphobranchus pinnatus.* 367–374 mm.
1 *Nemichthys scolopaceus.* 510 mm.
1 *Nettastoma procerum.* 190+ mm.

STATION 338.

1 *Coryphænoides carapinus.* 225 mm.
1 *Alepocephalus Agassizii.* 274 mm.
1 *Halosaurus macrochir.*

STATION 341.

1 *Coryphænoides carapinus.* Unfit to measure.
1 *Bathysaurus Agassizii.* 610 mm.

STATION 343.

1 *Glyptocephalus cynoglossus.* 260 mm.
13 *Macrurus Bairdii.* 245–361 mm.
2 *Coryphænoides carapinus.* 196 mm. One not measured.
1 *Cottunculus torvus.* 407 mm.

STATION 344.

8 *Merlucius bilinearis.* Young. 25–94 mm.

STATION 346.

3 *Phycis chuss.* 340–400 mm.

PLEURONECTIDÆ.

1. Aphoristia nebulosa, new species.

The extreme length of the type is 85 millimeters. The body is rather slenderer than in other species of the genus; its greatest height (18 mm.) is contained $4\frac{2}{3}$ times in the extreme length. The scales are small, rough, about 120 in a longitudinal series; about 50 in a transverse series. Jaws and snout scaleless. The length of the head (15 mm.) is contained $5\frac{2}{3}$ times in total length. The length of the snout (3 mm.) is $\frac{1}{5}$ that of the head. The eyes are small and close together, being separated by only a single row of scales; the upper eye is very slightly in advance of the lower. The tubular nostril is directly in front of the lower eye, and a little nearer to it than to the tip of snout. The length of the eye (2 mm.) is contained $7\frac{1}{2}$ times in length of head. The angle of the mouth is about in a vertical through the anterior margin of the lower pupil. Teeth feeble, very slender, and rather closely placed, apparently equally developed on the two sides.

The dorsal fin begins at a point slightly behind the eyes; it is connate with the caudal, and contains 119 rays to the middle of the base of the caudal; the rays about the middle of the fin are the longest, their height being a little more than one third that of the body.

The distance of the anal from the snout (20 mm.) is contained $4\frac{1}{4}$ times in extreme length; the longest rays are about the middle of the fin, their length (6 mm.) equalling twice that of the snout. The anal is connate with the caudal, and contains 107 rays, counting to the middle of the base of the latter fin.

The median caudal rays are longest, their length (6 mm.) equalling twice that of the snout.

Pectorals none.

The distance of the ventral from the snout (15 mm.) is contained $5\frac{2}{3}$ times in extreme length. The ventral is separated from the anal by an interspace twice as long as the eye. The number of ventral rays is five, the longest of them being one third as long as the head.

The vent is near the origin of the anal.

Color grayish, everywhere mottled with brown. The median keel on the scales dark and prominent.

Radial formula: D. 119; A. 107; V. 5; P. none.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
316	32° 7′	78° 37′ 30″	229	1

NOTOSEMA, new genus.

Four specimens of a new genus and species, belonging to the Flounder family, were dredged by the Blake at Station 313, off Charleston, S. C., at a depth of seventy-five fathoms.

In general appearance and size this species resembles *Paralichthys quadro-*

cellatus (Gill), Jordan and Gilbert. On account of its elongated ventral fin, the triangular elongation of the anterior rays of the dorsal, and the highly ctenoid character of the scales upon the colored side of the body, it seems necessary to establish for it a new genus.

A genus of pleuronectoid fishes, with elliptical body and pedunculate caudal fin. Mouth moderate in size, and beneath the central axis of the body. Eyes large upon left side, close together, the upper one nearly encroaching upon the profile, the lower slightly in advance of the upper. Teeth in single series in the jaws, about equally developed upon each side, much largest in front; absent on vomer and palatines. Pectoral fins somewhat unequal, that upon the blind side about three fourths as large as its mate. The dorsal fin commences slightly behind the anterior margin of the upper eye, and *the first eight rays are separated into a distinct subdivision of the fin, several of them being much prolonged.*

Caudal fin pedunculate, rounded posteriorly. *Sinistral ventral much elongated.* Scales small, ctenoid on colored side of body. Lateral line prominent, strongly arched over the pectoral, alike on both sides. Gill-rakers moderately numerous, rather stout, subtriangular, pectinate posteriorly. Pseudobranchiæ well developed. Vertebræ 35.

2. Notosema dilecta, new species.

Diagnosis of Species. — Extreme length of specimen described 0.122 mm.

The height of the body is contained twice in its total length, without caudal, and is equal to twice the distance of the origin of the ventral from the snout. The height of the caudal peduncle is one ninth of the standard body length.

The length of the head is two sevenths of the standard length, and three times the diameter of the eye. Width of interorbital area almost imperceptible. Mandible reaching to middle of pupil of lower eye, its length equal to half that of the head. Upper jaw contained twice and one half in length of head.

The dorsal fin, beginning almost over the anterior margin of the eye, is composed of about 68 rays, the longest of which are the second and third, which are contained twice in the greatest height of the body, and which are almost twice as long as the length of the base of the triangular division of the fin to which they belong.

The anal fin is made up of 54–56 simple rays, of which the posterior ones are largest, as they are also in the main portion of the dorsal. It begins close to the vent, at a distance from the snout equal to the length of the elongated sinistral ventral.

The caudal is pedunculate, its middle rays somewhate elongate, giving it a wedge-shaped outline.

The pectoral of the colored side is subtriangular, its length contained five and one half times in the standard length.

The ventrals are composed of six rays, that upon the colored side much produced in its anterior portion, its length more than three times that of its mate.

Color on the left side purplish brown, speckled with dark brown, and with three large ocellated subcircular spots, nearly as large as the eye, with white centre, dark iris, narrow light margin, and a brown encircling outline. They are arranged in the form of an isosceles triangle, the spot marking the apex being upon the lateral line, near the base of the caudal peduncle, the others distant from the lateral line, on either side, a space equal to their own diameters, the lower one nearly reached by the tip of the elongate ventral. On the blind side white. Fins blotched with dark brown.

Radial formula: D. 69; A. 56; P. 11; V. 6; B. 7. Lateral line 48 (in straight portion).

Station	N. Lat.	W. Long.	Fathoms.	Specimens.
313	32° 31′ 50″	78 45′	75	4

3. Monolene sessilicauda, Goode.

Monolene sessilicauda, Goode, Proc. U. S. National Museum, III. 1880, pp. 338, 472. (Nov. 23.)

Three specimens of this species were obtained from Station 314, lat. 32° 24′ N., long. 78° 44′ W., at a depth of 142 fathoms.

The species has also been found only by the U. S. Fish Commission off Newport, R. I., in 115 to 150 fathoms.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
314	32°	78° 44′	142	3

4. Citharichthys arctifrons, Goode.

Citharichthys arctifrons, Goode, *op. cit.*, pp. 341, 472. (Nov. 23.)

Eight young individuals, the longest measuring two inches, were dredged at Station 313, off Charleston, S. C., in 75 fathoms; also, three specimens, badly mutilated, from Station 336, lat. 38° 21′ N., long. 73° 32′ W., in 197 fathoms, and another large one at Station 311, lat. 39° 59′ 30″, long. 70° 12′ W., in 143 fathoms. Other small ones were from Station 314.

The peculiar elongated snout, similar to that of *Macrurus*, is attributable to age.

The species has also been taken by the U. S. Fish Commission off Newport in 83–155 fathoms.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
311	39° 59′ 30″	70° 12′	143	1
313	32° 31′ 50″	78° 45′	75	? 8 juv.
314	32° 24′	78° 44′	142	2
335	38° 22′ 5″	73° 33′ 40″	89	6
336	38° 21′ 50″	73° 32′	197	3 (bad)

5. Glyptocephalus cynoglossus (Linn.), Gill.

Pleuronectes cynoglossus, Linnæus, Syst. Nat., ed. X., I., 1758, p. 269.
Glyptocephalus cynoglossus, Gill, Proc. Acad. Nat. Sci., Phila., 1873, p. 161. Goode and Bean, Proc. U. S. Nat. Mus., I., 1878, p. 21 (with extensive synonymy). Goode, *op. cit.*, p. 475.

A single specimen of the Pole Flounder was obtained from Station 343, Lat. 39° 45′ 20″ N., Long. 70° 55′ W., in 732 fathoms. The occurrence of this species at such immense depths is noteworthy, since the Fish Commission in the same year obtained it at a depth of 120 fathoms, in almost the same latitude, and within one minute of the same longitude (Station 876).

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
343	39° 45′ 40″	70° 55′	732	1
334	38° 20′ 30″	73° 26′ 40″	395	1
332	35° 45′ 30″	74° 48′	263	2 juv.
329	34° 39′ 40″	75° 14′ 40″	603	Frag. of 1

MACRURIDÆ.

6. Macrurus Bairdii, Goode & Bean.

Macrurus Bairdii, Goode & Bean, Amer. Jour. Sci. and Arts, XIV., 1877, pp. 471–473 (Massachusetts Bay). Cat. Fish. Essex Co. and Mass. Bay, 1879, p. 7. Goode, Proc. U. S. Nat. Mus., III., 1880, p. 475.

Numerous specimens were obtained from the following stations: —

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
303	41° 34′ 30″	65° 54′ 30″	306	25
306	41° 32′ 50″	65° 55′	524	12
309	40° 11′ 40″	68° 22′	304	13
312	39° 50′ 45″	70° 11′	466	12
316	32° 7′	78° 37′ 30″	229	2 juv.
317	31° 57′	78° 18′ 35″	333	1
325	33° 35′ 20″	76°	647	2
326	33° 42′ 15″	76° 0′ 50″	464	21
329	34° 39′ 40″	75° 14′ 40″	603	1
332	35° 45′ 30″	74° 48′	263	1 juv.
334	38° 20′ 30″	73° 26′ 40″	395	4
336	38° 21′ 50″	73° 32′	197	2
337	38° 20′ 8″	73° 23′ 20″	740	1
343	39° 45′ 40″	70° 55′	732	13

7. Macrurus carminatus, Goode.

Macrurus carminatus, Goode, Proc. U. S. Nat. Mus., III., 1880, pp. 346, 475 (Nov. 23).

The Fish Commission obtained individuals in 1880 in the same region, at depths of 115, 155, 225, and 372 fathoms.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
321	32° 43′ 25″	77° 20′ 30″	233	Fragments of 6
326	33° 42′ 15″	76° 0′ 50″	464	1 very bad

8. Macrurus asper, new species.

The relations of this species appear to be with *M. Bairdii*, from which it differs in (1.) its longer snout, (2.) the location of the vent, which is much farther back, and (3.) the absence of keels upon any of its scales.

The length of the specimen described is 322 millimeters. The body is much stouter than in *M. Bairdii*, its greatest height being contained $6\frac{1}{2}$ times in its length. The scales are small, strong, the free portions covered with vitreous spines arranged in about seven rows ; there is no specialization of the central row, as in *M. Bairdii*, though the median spine at the margin of the scale projects most strongly. The number of scales in the lateral line is about the same, there being about 150 ; there are 7 above and 18 below the line.

Length of head contained $5\frac{2}{3}$ times in total length. Width of interorbital area a little greater than horizontal diameter of orbit and length of operculum, and contained $4\frac{1}{4}$ times in the length of the head. Length of snout about equal to width of interorbital space and about one half the postorbital portion of the head. Snout triangular, depressed, its tip in the axis of the body, and nearly on a level with the lower margin of the eye ; its lower surface forming an angle with the body axis, about equal to that formed with same by its upper profile. The superior ridge is pronounced anteriorly, but ends in advance of the concavity in the interorbital space. The lateral ridges are prominent, and continue posteriorly to the eye, with strong angular projections in front of the nostrils. No ridges continued from supraorbital region. Nostrils rather close to the eye. Barbel shorter than the eye. Tip of lower jaw under anterior nostril, cleft of mouth under posterior margin of orbit.

Teeth in the jaws in a very narrow villiform band, the outer series slightly larger : those in lower jaw apparently in single series, moderate.

Distance of first dorsal from snout equal to nearly four times the length of its base, its distance from the anterior margin of the orbit equal to the length of the head. First spine minute ; second spine nearly two thirds the length of the head, and when laid down is far from reaching to the origin of the second dorsal. When the fin is erect, its superior margin is nearly at right angles to the plane of the back, and slightly convex. The distance between the two

dorsals is twice the length of the base of the first, the second beginning in the perpendicular from the fifth ray of the anal.

The anal is about three times as high as the second dorsal. The vent is under the 30th scale of the lateral line directly in advance of the anal, and at a distance from the ventral considerably greater than the length of that fin, in this respect differing widely from *M. Bairdii*.

Distance of pectoral from snout slightly more than the length of the head. Its length is less than that of the dorsal spine, and slightly more than half its distance from the snout. Its insertion (upper axil) is in the middle line of the body.

Insertion of ventral under that of pectoral, and slightly in advance of that of dorsal. Its first ray is not greatly prolonged, and is about half as long as the distance of the fin from the snout.

Radial formula: 1st D. II, 8–9; 2d D. 105; A. 110; P. 20; V. 10. Scales, 7–150–18.

Color dark reddish brown, the spines upon the scales with a metallic lustre.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
308	41° 24′ 25″	65° 35′ 30″	1242	5
309	40° 11′ 40″	68° 22′	304	1

9. Coryphænoides rupestris, Gunnerus.

Coryphænoides rupestris, Gunnerus, Thjemske. Selsk. Skr. 3, 1765, p. 50. Collett, Norges Fiske, p. 131.

A specimen was taken at station 306. The species has been sent to the National Museum by Gloucester fishermen.

Station.	N. Lat.	W. Long.	Fathoms.	Specimen.
306	41° 32′ 50″	65° 55′	524	1

10. Coryphænoides carapinus, new species.

Several specimens were obtained from various stations of the "Blake." Most of these had their tails broken off, and all of them were completely denuded of scales, — a natural consequence of their passage in the nets from the ocean depths. By a happy chance, two scales were found attached to the base of the dorsal fin of one of the larger individuals, thus enabling us to determine the general character of the covering of the body. The description of this species is necessarily meagre.

Diagnosis. — Scales 22 to 24 in a transverse series; (the position of the lateral line cannot be determined, but there appear to be four above it;) the scales are oval, membranous, without armature, and rather large. The first ray of the dorsal is very short; the second, compressed anteriorly and serrated, with slender teeth closely appressed and bent upwards. Its length is equal to the length of the head, and is greater than the height of the body. This fin

is seated upon a lump-like elevation of the back, and its base is as long as the snout.

The second dorsal begins over the tenth to twelfth anal ray, and at a distance from the end of the first dorsal equal to the length of the head without the snout. The vent is located not far behind the vertical from the end of the first dorsal.

The snout is acute, projecting beyond the mouth, its tip at a distance from the mouth equal to or greater than the diameter of the eye. The bones of the head are very soft and flexible, and its surface is very irregular, there being a very prominent subocular ridge, a prominent ridge extending from the tip of the snout to the middle of the interorbital space, and a curved ridge extending from the upper anterior margin of the orbit, over the cavity containing the nostrils, to a prominent point, at the side of, and slightly posterior to tip of the snout. The barbel is two thirds as long as the eye. The eye is contained in the head four times, and the length of the head in the total length six times.

Radial formula : D. II, 8, 100 ; A. 117 ; V. 10.

The upper jaw extends to the vertical through the posterior margin of the pupil ; its length equals half that of the head without the snout. The mandible extends behind the vertical through the posterior margin of the orbit ; its length is contained three times in the distance from the tip of the snout to the origin of the first dorsal.

The interorbital space is almost twice the diameter of the eye, and is equal to the length of the upper jaw. The preoperculum is crenulate.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
308	41° 24′ 45″	65° 35′ 30″	1242	2
308	"	"	"	2
341	39° 38′ 20″	70° 56′	1241	1
Unknown.				6
338	38° 18′ 40″	73° 18′ 10″	922	1
342	39° 43′	70° 55′ 25″	1002	2

CHALINURA, new genus.

Scales cycloid, fluted longitudinally with slightly radiating s' iæ. Snout long, broad, truncate, not much produced. Mouth lateral, subterminal, very large. Head without prominent ridges save the subocular ones, and those upon the snout. The suborbital ridge is not joined to the angle of the preoperculum. Teeth in the upper jaw in a villiform band, with those in the outer series much enlarged ; those in lower jaw uniserial, large. No teeth on vomer or palatines. Pseudobranchiæ present, but small. Gill-rakers spiny, depressible, stout, in double series on the anterior arch. Branchiostegal membrane apparently free from the isthmus. Ventrals below the pectorals. Barbel present.

11. Chalinura simula, new species.

A single specimen, 458 millimeters in length, was obtained at Station 308. In some respects it resembles the description of *Coryphænoides affinis*, Günther, obtained by H. M. S. "Challenger" at a depth of 1900 fathoms, east of the mouth of the Rio Plata.

The most salient characters are (1.) the very large mouth, (2.) the long obtuse snout, and (3.) the very elongate first ventral ray.

The body is shaped much as in *Coryphænoides*, but is rather stout, its greatest height being contained $6\frac{2}{3}$ times in its total length. The back is somewhat gibbous in profile, the dorsal outline rising quite rapidly from the interorbital region to the origin of the first dorsal, whence it descends almost in a straight line to the end of the tail.

The scales are rather small, cycloid, without armature, but with indications, particularly on the head, of radiating striæ. The number of scales in the lateral line is about 150, about eight rows between the origin of the dorsal and the lateral line, and 17 to 19 between that line and the origin of the anal.

The length of the head is contained about $5\frac{1}{7}$ times in the total length of the body. The width of the interorbital area is a little greater than the long diameter of the orbit, which is equal to that of the snout. The postorbital portion of the head is about three times as long as the diameter of the eye. The length of the operculum is equal to half that of the upper jaw. The preoperculum is emarginate on its posterior limb. The orbit is nearly round, its diameter contained five times in the length of the head. The snout is broad, obtuse, scarcely projecting beyond the mouth; its width nearly as great at the tip as that of the interorbital space or as its own length. The median ridge is very prominent, gibbous in outline when observed laterally; the lateral ridges start out almost at a right angle with the median ridge, and are not continued upon the sides of the head. The suborbitals prominent, forming broad subocular ridges. No supraorbital ridges. Nostrils in front of the middle of the eye, and nearer to its anterior margin than to the tip of the snout. Barbel longer than the diameter of the eye.

Teeth in the upper jaw in a broad villiform band, with the outer series very much enlarged. The lower jaw with the teeth in a single series.

Distance of first dorsal from snout $4\frac{1}{3}$ times the length of its base, its distance from the anterior margin of the orbit about equal to the length of the head. First spine very short, second rather stout and with a simple serration anteriorly, the serræ closely appressed to the spine (the spines all broken at their tips).

The second dorsal begins at a distance from the first about equal to the length of the upper jaw.

The anal is high, its average rays being about three times as long as those in the dorsal. It is inserted slightly behind the perpendicular from the last ray of the first dorsal. The pectoral is inserted over the base of the ventral (its

rays are mutilated). The ventral is inserted almost under the pectoral, but very slightly in advance ; its distance from the snout is less than the length of its longest ray, which is prolonged in a filament which extends to the base of the 18th ray of the anal fin.

Radial formula : D. I, IX, 113 ; A. 118 ; P. 20 ; V. 9 ; B. VI.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
308	41° 24′ 45″	65° 35′ 30″	1242	1
317	31° 57′	78° 18′ 35″	333	1 juv. apparently of this species.

Length of adult, 481 millimeters ; of young, about 25 millimeters.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
325	33° 35′ 20″	76°	647	2 juv., and very rotten, probably belonging to the above species.

BROTULIDÆ.

BARATHRODEMUS, new genus.

Diagnosis. —Body brotuliform, much compressed; head considerably compressed with mouth moderate (in the type species extending to the vertical through the middle of the eye). Eye moderate. Head spineless, except a short flattened spine at the upper angle of the operculum. Snout long, projecting far beyond the tip of the upper jaw, its extremity much swollen. Jaws nearly equal in front. Teeth minute in villiform bands on jaws, vomer, and palatines. Barbel none. Anterior pair of nostrils open and situated at the outer angles of the dilated snout, circular, each surrounded with a cluster of mucous tubes. Posterior nostrils over anterior upper margin of orbit. Gill openings wide, membranes not united. Gills four, with a slit behind the fourth : gill laminæ moderate in length. Gill rakers also moderate : not numerous. Pseudobranchiæ absent : a small, separate caudal fin considerably prolonged.

Dorsal and anal fins long. Branchiostegals, eight. Body and head covered with small, thin scales, those on the body scarcely imbricated. Lateral line absent (?). Ventrals reduced each to a single bifid ray, close together, far in front of the pectorals.

12. Barathrodemus manatinus, new species.

Two specimens of this species of *Barathrodemus*, six and a quarter inches in length, were obtained at Station 325, lat. 33° 35′ 20″, long. 76°, at a depth of 647 fathoms.

Description. — Body much compressed. Dorsal and anal outline approaching at an equal angle the horizontal axis. The height of the body is contained $7\frac{1}{2}$ times in its total length without caudal, and $8\frac{1}{3}$ times with caudal included. Scales small; about 175 rows between the branchial opening and the tail; and

about 34 rows, counting upward and forward obliquely from the origin of the anal to the dorsal line. Lateral line apparently absent.

Head considerably compressed, with rounded upper surface, its length contained about six times in total body length; its width contained $2\frac{1}{2}$ times in its length; its greatest height equal to two thirds its length. Snout slightly longer than the horizontal diameter of the eye, and projecting beyond the tip of the upper jaw a distance equal to the vertical diameter of the eye; much dilated and swollen, the anterior pair of nostrils being situated at the most salient angles; the snout in general form resembling that of a manatee, whence the specific name.

Mouth moderate; its cleft extending to the vertical from the centre of the orbit. Length of the upper jaw equal to twice the horizontal diameter of the eye, and contained $2\frac{1}{2}$ times in the length of the head. The posterior portion of the maxilla is considerably expanded. The maxilla is largely included within a skinny sheath. When the mouth is closed, the lower jaw is entirely included within the upper. Maxilla toothless. Vomer and palatine bands of teeth more than twice as broad as the bands in the intermaxillaries and on the mandible.

Eye elliptical in form. Its vertical diameter two thirds of its horizontal, the latter being equal to the distance from the tip of the snout to the posterior nostril, and contained $5\frac{1}{4}$ times in the length of the head. The distance of the eye from the dorsal outline is equal to half its horizontal diameter, and to one fifth of the height of the head in a perpendicular through the centre of the eye. Interorbital space rounded: its width equal to the horizontal diameter of the eye.

Dorsal fin inserted in the vertical above the insertion of the pectoral, at a distance from the end of the snout equal to that of the insertion of the pectoral.

Anal inserted under the 21st to 23d dorsal ray, and at a distance from the snout about equal to one third the body length. The height of the dorsal and anal fins is about equal to half the height of the body at the insertion of the anal. Their bases extend almost to the insertion of the caudal.

The caudal is composed of nine rays, the five medial ones almost equal in length, though the tip of the tail is slightly rounded, about equal to the height of the body midway between the branchial opening and the base of the tail.

The ventrals are inserted almost under the middle of the operculum; in length about equal to half the length of the head.

The pectorals are inserted under the origin of the dorsal, and at a distance behind the branchial opening equal to two thirds the vertical diameter of the eye. Their length is equal to the greatest height of the body.

Color, grayish brown. Abdominal region black.

Radial formula: D. 106; A. 86; C. 2 + 5 + 2; P. 18–20; V. $\frac{1}{1}$.

L. lat., ca. 175.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
325	33° 35′ 20″	76°	647	2

DICROLENE, new genus.

Diagnosis. — Body brotuliform, moderately compressed; head somewhat compressed, with mouth large (in the type species extending nearly to the posterior margin of the eye). The tip of the maxillary much dilated. Eye large, placed close to the dorsal profile. Head with supraorbital spines: several strong spines on the preoperculum, and one long spine at the upper angle of the operculum. Snout short, not projecting beyond the upper jaw. Jaws nearly equal in front. Teeth in narrow villiform bands in the jaws on the head of the vomer, and on the palatines. Barbel none. Gill openings wide: membranes not united. Gills four: gill laminæ of moderate length. Gill rakers rather long, not numerous. Pseudobranchiæ absent. A small, separate caudal fin, much prolonged. Dorsal and anal fins long: rays of the pectoral fin arranged in two groups: several of the lower rays being separate and much produced. Ventral fins close together, far in front of the pectorals. Each ventral composed of a single bifid ray. Branchiostegals seven. Body and head covered with small scales. Lateral line close to the base of the dorsal fin, apparently becoming obsolete on the posterior third of the body. Stomach siphonal. Pyloric cæca few, rudimentary. Intestine shorter than body.

13. Dicrolene introniger, new species.

Several specimens of a species of *Dicrolene* were obtained from Stations 325 and 326.

Body moderately compressed, its dorsal and anal outlines approaching at an equal angle the horizontal axis, and tapering to a narrow point, which forms the base of the caudal fin. Scales small, about 110 rows between the branchial opening and the tail, and about 27 transverse rows counting upward and forward obliquely from the origin of the anal. The lateral line rudimentary, running near the base of the dorsal fin at a distance from it less than the diameter of the eye, and apparently becoming obsolete on the posterior third of the body. Body height one sixth of standard length.

Head somewhat compressed, with flattish upper surface, which is encroached upon by the upper margins of the orbit. At the posterior upper margin of each orbit is a strong spine pointing backward and upward; a long sharp spine at the upper angle of the operculum, its exposed portion as long as half the diameter of the eye. Preoperculum, on its lower posterior border, with three equidistant spines much weaker than that of the operculum. Large muciferous cavities in the bones of the head: a row of large cavities extending backward from the upper angle of the orbit, and continuous with those on the lateral line. Mouth large: its cleft considerably longer than half the length of the head, and the maxillary extending behind the vertical from the posterior margin of the orbit. The posterior portion of the maxillary much expanded, its width at the end equal to three fourths the diameter of the eye. Upon its

expanded tip are scales. Eye large, one fourth as long as head, and as wide as the interorbital space. Length of head one fifth standard length.

Dorsal fin inserted at a distance from the snout equal to two ninths the length of the body.

Anal inserted under the vertical from the 25th or 26th dorsal ray. The height of the dorsal and anal fins is about equal to the diameter of the eye. Their bases extend almost to the insertion of the caudal.

The caudal is composed of six or seven rays : its length equal to half the distance from the snout to the insertion of the dorsal.

The ventrals inserted almost under, but slightly posterior to, the posterior limb of the preoperculum, in length about equalling the upper jaw.

Pectorals inserted close to the branchial aperture ; the eight lower rays being free and much prolonged, the longest and most anterior being nearly one third as long as the body, and more than three times as long as the contiguous posterior ray of the normally-constructed portion of the fin, which is, however, about equal to the last of the free rays. The free portion of the pectoral being longer, and composed of fewer rays, than the normal portion, the fish has the appearance of bearing two pectoral fins of the same general shape, the lower of which is the longer. The length of the normal portion of the fin is contained about four times in the length of the body.

Radial formula : D. 100 ; A. about 85 ; C. 6 or 7 ; V. $\frac{1}{1}$; P. 19 + 7 or 8. L. lat. 110–120.

Station.	N Lat.	W. Long.	Fathoms.	Specimens.
326	33° 42′ 15″	76° 0′ 50″	464	4
325	33° 35′ 20″	76°	647	7

GADIDÆ.

14. Phycis chuss (Walb.), Gill.

Blennius chuss, Walbaum, Artedi, 1792, p. 186.
Phycis chuss, Gill, Proc. Acad. Nat. Sci. Phila., 1862, p. 237.

This species occurred at the following stations.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
311	39° 59′ 30″	70° 12′	143	1
346	40° 25′ 35″	71° 10′ 30″	44	3

15. Phycis tenuis (Mitch.), Dekay.

Gadus tenuis, Mitchill, Trans. Lit. & Phil. Soc. N. Y., 1814, p. 372.
Phycis tenuis, DeKay, Zoöl. New York, Fishes, 1842, p. 293.

Taken in the following locality.

Station.	N. Lat.	W. Long.	Fathoms.	Specimen.
309	40° 11′ 40″	68° 22′	304	1

16. Phycis regius (Walb.), Jordan & Gilbert.

Blennius regius, Walbaum, Artedi, 1792, p. 186.
Urophycis regius, Gill, Proc. Acad. Nat. Sci. Phila., 1863, p. 240.
Phycis regius, Jordan & Gilbert, Proc. U. S. Nat. Mus., I., 1878, p. 371. Goode & Bean, Cat. Fish. Essex Co. and Mass. Bay, 1879, p. 8; Bean, Proc. U. S. Nat. Mus., III. p. 70; Goode, ibid., p. 476 (with synonymy).

Specimens of this beautiful Hake were obtained at depths of 142 and 233 fathoms. Prof. Agassiz and the officers of the "Blake" had their attention forcibly attracted to a singular power of emitting electric shocks possessed by this fish. This peculiarity has never been noticed in this species save in deep water. The attention of observers is called to this interesting point.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
333	35° 45′ 25″	74° 50′ 30″	65	5
314	32° 24′	78° 44′	142	1
321	32° 43′ 25″	77° 20′ 30″	233	3

17. Phycis Chesteri, Goode & Bean.

Phycis Chesteri, Goode & Bean, Proc. U. S. Nat. Mus., I., 1878, p. 256; Cat. Fish. Essex Co. and Mass. Bay, 1879, p. 8; Goode, Proc. U. S. Nat. Mus., III. p. 476.

Numerous specimens of this fish were taken at various depths. These collections confirm the view expressed after a study of the collections made by the Fish Commission in the same year; namely, that *Phycis Chesteri* and *Macrurus Bairdii* appear to be the most abundant fishes in the continental slope from 140 to 500 fathoms, occurring in immense numbers and breeding copiously.

Following is a list of the stations.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
Unknown.				5
336	38° 21′ 50″	73° 32′	197	7
303	41° 34′ 30″	65° 54′ 30″	306	4

LÆMONEMA, Günther.

Læmonema, Günther, Cat. Fish. Brit. Mus., IV., p. 356, 1862.

18. Læmonema barbatula, new species.

Head contained in body (without caudal) $4\frac{2}{5}$ times; height of body $4\frac{1}{2}$ times. Diameter of orbit in length of head three times, upper jaw a little more than twice. Barbel half as long as the diameter of the eye. Vent situated under the sixth or seventh ray of second dorsal. Distance of first dorsal from snout

equal to one fourth standard length of body. The base of the first dorsal is half as long as the middle caudal rays ; that of the second, slightly more than three times the length of the head. The first dorsal is composed of five rays, the first of which is elongate, three times as long as the middle caudal rays : it extends to the base of the twenty-fourth ray of the second dorsal. Anal fin inserted at a distance from the tip of the snout equal to twice the length of the head, its distance from the insertion of the ventrals being equal to the length of the head. The length of the ventrals is equal to that of the pectorals, their tips not extending to the vent.

Scales small, very thin, deciduous, crowded anteriorly. Lateral line not well defined on the posterior part of the body.

Radial formula : B. VII ; D. 5–63 ; A. 59 ; P. 19 ; V. 2.

Scales 13–140–31.

Color similar to that of the various species of *Phycis ;* the dorsal and anal fins have narrow black margins.

The length of the first dorsal ray is very variable in individuals, being shorter in younger specimens.

This species differs from *L. Yarrellii* by its much smaller scales, and from *L. robustum* by the greater number of rays in the dorsal and anal fins, and its much shorter ventrals.

Specimens of this species were obtained at the following stations of the steamer "Blake."

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
321	32° 43′ 25″	77° 20′ 30″	233	1 and part of 1
315	32° 18′ 20″	78° 43′	225	2
316	32° 7′	78° 37′ 30″	229	3

A single specimen was also obtained by the Fish Commission steamer "Fish Hawk" in Lat. 38° 35′ N., Long. 73° 13′ W., at a depth of 312 fathoms, Oct. 10, 1881 (U. S. Nat. Mus., No. 29,046).

MEASUREMENTS.

	Millimeters.
Extreme length	178
Length to base of middle caudal rays	160
Body. Greatest height	36
Greatest width	18
Height at ventrals	32
Least height of tail	4
Head. Greatest length	33
Greatest width	20
Width of interorbital area	7
Length of snout	7
Length of upper jaw	15
Length of mandible	17

Distance from snout to orbit	9
Diameter of orbit	11
Dorsal (*first*). Distance from snout	40
Length of base	9
Length of longest ray	54
(*second*). Length of base	105
Length of first ray	14
Length of longest ray	17
Anal. Distance from snout	65
Length of base	86
Length of first ray	7
Length of longest ray	16
Length of last ray	3
Caudal. Length of middle rays	18
Pectoral. Distance from snout	36
Length	25
Ventral. Distance from snout	30
Length	25
Branchiostegals	VII
Dorsal	5–63
Anal	59
Caudal	
Pectoral	19
Ventral	2
Number of scales in lateral line	ca. 140
Number of transverse rows above lateral line	13
Number of transverse rows below lateral line	31

19. Haloporphyrus viola, Goode & Bean.

Haloporphyrus viola, Goode & Bean, Proc. U. S. Nat. Mus., I. pp. 257–260, Dec. 17, 1878.

Specimens were obtained at the following stations.

Station	N. Lat.	W. Long.	Fathoms.	Specimens.
305	41° 33′ 15″	65° 51′ 25″	810	1
308	41° 24′ 25″	65° 35′ 30″	1242	5
306	41° 32′ 50″	65° 55′	524	13
325	33° 35′ 20″	76°	647	1
312	39° 50′ 45″	70° 11′	466	2
Unknown.				1
337	38° 20′ 8″	73° 23′ 20″	740	1
303	41° 34′ 30″	65° 54′ 30″	306	1

20. Onos cimbrius (Linn.), Goode & Bean.

Gadus cimbrius, Linn., Syst. Nat., ed. XII., 1766, p. 440.
Onos cimbrius, Goode & Bean, Proc. U. S. Nat. Mus., I. p. 349, Feb. 14, 1879.

A single specimen, 70 mm. long, of a species of *Onos*, apparently *O. cimbrius*, was taken at Station 327. It was in fragments when received.

Station.	N. Lat.	W. Long.	Fathoms.	Specimen.
327	34° 0′ 30″	76° 10′ 30″	178	1 bad.

21. Merlucius bilinearis (Mitch.), Gill.

Stomodon bilinearis, Mitchill, Rep. Fish. N. Y., 1814, p. 7.
Merlucius bilinearis, Gill, Cat. Fish. E. Coast N. A., 1861, p. 48.

Specimens mostly young were obtained at several stations enumerated below. A reference to the list of stations will show that the very young, not more than 25 millimeters in length, were secured.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
313	32° 31′ 50″	78° 45′	75	2
311	39° 59′ 30″	70° 12′	143	1
321	32° 43′ 25″	77° 20′ 30″	233	1
344	40° 1′	70° 58′	129	8 juv.

LYCODIDÆ.

22. Lycodes Verrillii, Goode & Bean.

Lycodes Verrillii, Goode & Bean, Amer. Jour. Sci. and Arts, Vol. XIV., Dec., 1877, pp. 474–476.

This species was collected at the three following stations.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
309	40° 11′ 40″	68° 22′	304	2
329	34° 39′ 40″	75° 14′ 40″	603	2
332	35° 45′ 30″	74° 48′	263	6

23. Lycodes paxilloides, new species.

This species resembles *Lycodes paxillus*, Goode & Bean, in many respects, but differs markedly in the smaller mouth and less prominent cheeks.

Diagnosis. — The length of the head is contained about eight times in the total length. The greatest height of the body is about half the length of the head. The dorsal begins over the end of the extended pectoral : its distance

from the tip of the snout is contained $4\frac{2}{3}$ times in the total length ; that of the anal from the snout, $3\frac{1}{3}$ times. The vent is immediately in front of the anal. The length of the pectoral equals one half that of the head, or a little more. The distance of the ventral from the snout is contained $8\frac{1}{2}$ times in the total length. The length of the ventral is scarcely more than that of the pupil. The interorbital space (on the skull) is about one fourth the length of the snout, which is about equal to that of the eye, which is contained $3\frac{1}{2}$ times in the length of the head. The tubular nostril is much nearer the tip of the snout than to the eye. The scales are very small, present everywhere except on the head and the pectorals, extending almost out to the margin of the vertical fins. Dorsal (with half of caudal) 118 rays ; anal (with half of caudal) 110. Pectoral 16, ventral 3. Color light brown, the head somewhat darker.

Specimens were obtained at the following places.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
309	40° 11′ 40″	68° 22′	304	2
312	39° 50′ 45″	70° 11′	466	1

LYCODONUS, new genus.

This genus is in nearly every particular like *Lycodes*, from which, however, it is distinguished by the peculiar structure of the dorsal and anal fins.

Diagnosis. — Body blenniform, elongate. Scales small, circular, imbedded in the skin. Lateral line very short, posteriorly obsolete. Eye moderate. Jaws without fringes. Upper jaw longer than lower. Fin rays soft, articulated ; *those of the dorsal and anal fins supported laterally, each by a pair of sculptured ectodermal scutes or plates.* Caudal distinct ; *not fully connate with dorsal* and anal, few-rayed. Ventrals present, jugular each composed of a few slender deeply cleft articulated rays. Gill opening rather narrow. Branchiostegal membranes broadly joined to the isthmus. Teeth as in *Lycodes.* Pseudobranchiæ apparently present. Branchiostegals apparently five. Gill arches four. Gill rakers rudimentary, in moderate number. Air bladder and pyloric cæca apparently absent.

Lycodonus mirabilis, new species.

The body is shaped much as in *Lycodes Verrillii ;* its greatest height, at origin of dorsal, contained about eighteen times in the length of the body. Scales as in *Lycodes*, the scales not extending out upon the fins. The head and nape are also scaleless. Lateral line apparently obsolete posteriorly, not extending back of the extremity of the pectoral.

The length of the head is contained about seven times in the entire length. The diameter of the eye is contained $2\frac{1}{2}$ times in the length of the head, and is about equal to the postorbital portion of the head. The eye is placed high, the width of the interorbital space being less than the diameter of the pupil, and

contained $3\frac{1}{2}$ times in the long diameter of the eye. Nostrils immediately in front of the eye. Teeth as in *Lycodes*. The maxilla extends to the vertical through the anterior margin of the pupil ; the mandible, to a little behind the vertical through the posterior margin of the pupil.

The dorsal fin is inserted slightly behind the vertical through the base of the pectoral ; the portion of the fin present in the mutilated specimen before us contains 80 articulated rays. The first ten or eleven scutes do not support rays, but whether rays were originally present or not cannot now be ascertained. The longest dorsal ray is about equal to the longest anal ray, its length being contained about three times in that of the head. The distance of the vent from the snout is twice the length of the head ; the anal begins immediately behind the vent ; it consists at present of about 70 articulated rays. The caudal rays extend beyond the tips of the ultimate dorsal and anal rays ; they are about 9 in number.

The distance of the ventral from the snout is equal to twice the length of the upper jaw ; the middle ventral ray is the longest, it being half as long as the postorbital part of the head.

The length of the pectoral equals three times that of the snout.

Radial formula : D. 80+ ; A. 70+ ; C. 9 ; P. 18 ; V. 3.

The single mutilated specimen was from Station 337. It measured 112 millimeters in its imperfect condition.

Station.	N. Lat.	W. Long.	Fathoms.	Specimen.
337	38° 20′ 8″	73° 23′ 20″	740	1

25. Melanostigma gelatinosum, Günther.

Melanostigma gelatinosum, Günther, Proc. Zoöl. Soc. London, 1881, Part 1, Jan. 4, p. 21 (genus, p. 20), Pl. II. fig. A.

A single greatly mutilated specimen, 103 mm. long, was obtained.

It has since been taken by the U. S. Fish Commission, in the deep water off Martha's Vineyard.

This species was described from a specimen obtained, January 16, 1880, by Dr. Coppinger, of H. M. S. Steamer "Alert," at Tilly Bay in the Straits of Magellan, in 24 fathoms. Dr. Günther remarks (*op. cit.*, p. 21), "The fish is evidently habitually living at a greater depth than that at which Dr. Coppinger happened to obtain the single specimen in his collection." This does not seem to us to be necessarily a logical conclusion, since, as is well known to those who have studied the distribution of deep-sea forms in the Western Atlantic, those which are found at great depths in temperate seas are shore inhabitants in seas near the poles.

Station.	N. Lat.	W. Long.	Fathoms.	Specimen
334	38° 20′ 30″	73° 26′ 40″	395	1 (fragments)

TRIGLIDÆ.

26. Prionotus alatus, new species.

A single specimen of a new species of *Prionotus* was obtained off Charleston, S. C., in the same haul with the pleuronectoid described above under the name *Notosema dilecta*. This species belongs to the group referred by Jordan to the subgenus *Ornichthys* of Swainson.

Description. — A *Prionotus* with the body normal in form, rather robust: its greatest height equal to one fourth its length without caudal, and nearly equal to one fifth of the total length; its greatest width one fifth of its greatest length without caudal; the least height of tail contained twelve times, or nearly so, in the standard body length, and three times in the height of the body.

Scales small and much pectinate, there being in the lateral line about one hundred vertical rows of scales, about fifty of which are tube-bearing and specialized. The number of rows, counting diagonally around the body from the origin of the anal, is twenty-one below and seven above the lateral line. The length of the head to the tip of the preopercular spine is contained two and a half times in the standard body length, and very little more than three times in the total length. The width of the head is equal to its height. The upper limb of the orbit encroaches upon the upper profile of the head, and the centre of the pupil is equidistant from the tip of the snout and the tip of the prolonged preopercular spine. The length of the snout, measured obliquely from the anterior margin of the orbit, is equal to that of the postorbital portion of the head to the end of the opercular spine. At the lower angle of the preoperculum is a robust spine, curving slightly upwards, the length of which is equal to that of the first dorsal ray. This spine is serrated upon its outer edge, and has a small spine at its base, which is also serrated. The tip of the spine extends to the perpendicular from the centre of the interspace between the third and fourth dorsal spines; while that of the humeral spine extends to the perpendicular from the interspace between the fourth and fifth, and that of the opercular, to the perpendicular from the centre of the base of the third. There is a strong scapular spine, which extends back to the posterior edge of the second dorsal spine.

The length of the upper jaw is equal to one third that of the head. The palatine teeth are in short feeble bands, hardly perceptible even with a strong magnifying-glass. Gill rakers, six in number, besides several rudimentary ones, five being below the angle, and the longest equal in length to one third the diameter of the eye.

The first dorsal fin is inserted above the tip of the upper opercular spine, and at a distance from the snout equal to twice the length of the fourth dorsal spine. The height of the first dorsal spine, which is equal to that of the third, and slightly less than that of the second, equals half the length of the head.

Its anterior margin is strongly serrated, while those of the second and third spines are less markedly so. The length of base of first dorsal equals the greatest height of body: the distance between its insertion and that of the second dorsal fin is equal to the length of the longest and superior detached pectoral ray. The second dorsal fin is inserted in the perpendicular over the interspace between the second and third anal rays : the length of its longest ray equals twice the least height of tail, and the length of its base equals the greatest length of the ventral rays. Its first ray is conspicuously serrated on its anterior edge.

The insertion of the anal fin is in the perpendicular below the end of the first dorsal fin : the length of its longest ray is equal to half that of the middle caudal rays.

The caudal is truncated, very slightly emarginate.

The pectoral is very peculiar in structure, its longest ray, the 9th, reaching to the base of the caudal rays, and equal in length to four times that of the fourth dorsal spine. The 10th ray is a little bit shorter, extending nearly to the end of the soft dorsal. The 11th, 12th, and 13th rays are graduated, decreasing in regular proportion, the 13th being less than one fourth as long as the 10th. The 8th is about midway between the 10th and 11th : the 1st is slightly longer than the 12th, and those intermediate between the 1st and the 8th are graduated in length, so as to form a rounded outline for the anterior, or upper, portion of the fin. The pectoral appendages are slender, the third being slightly greater in length than the 13th ray, being two thirds as long as the first, while the second is intermediate between the other two.

The ventral is inserted directly under the base of the pectoral appendages : its first spine about equal in length to the preopercular spine from the base of the supplemental spines ; its longest, the third and fourth, exactly equal in length to the base of the second dorsal.

Color, brownish above, with about four indistinct transverse band-like blotches, one of which is on the base of the caudal ; whitish beneath. Vertical fins uniform, the tips of the caudal rays blackish, with two indistinct cloud-like bands in advance of the terminal band thus formed. A black blotch, with whitish anterior margin on the membrane between the fourth and fifth dorsal spines ; a very inconspicuous blackish spot on the membrane between the fifth and sixth ; others still less conspicuous on the succeeding interspaces. The pectoral blotched and clouded with blackish brown and white.

Radial formula : D. X, 12 ; A. 11 ; C. 3 — 7 + 5 — 4 ; P. 13 + 3 ; V. I, 5.

L. lat. about 100. Tube-bearing scales, about 50.

Station.	N. Lat.	W. Long.	Fathoms.	Specimen.
313	32° 31′ 50″	78° 45′	75	1

AGONIDÆ.

27. Peristedium miniatum, Goode.

Peristedium miniatum, Goode, Proc. U. S. Nat. Mus., III. pp. 349, 350, Nov. 23, 1880.

Young individuals were trawled at the following stations.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
327	34° 0′ 30″	76° 10′ 30″	178	1
314	32° 24′	78° 44′	142	4

COTTIDÆ.

28. Icelus uncinatus (Reinhardt), Kröyer.

Cottus uncinatus, Reinhardt, "Overs. Kgl. D. Vid. Selsk. Naturv. Math. Afh. 6 Del., p. xliv., Copenhagen, 1837 (1833–34)."

Icelus uncinatus, Kröyer, Naturh. Tidssk., 2ser., B. I., p. 263, 1844.

Centridermichthys uncinatus, Günther, Catalogue of the Fishes in the British Museum, II., 1860, p. 172. Collett, Norske Nordhavs-Expedition, 1876-78, Fiske, p. 29, pl. 1, fig. 7.

A single specimen, much mutilated, was taken at Station 303.

Station.	N. Lat.	W. Long.	Fathoms.	Specimen.
303	41° 34′ 30″	65° 54′ 30″	306	1

29. Cottunculus microps, Collett.

Cottunculus microps, Collett, Norges Fiske, Appendix to Forh. Vidensk. Selskab., Christiania, 1874, p. 20, pl. 1, figs. 1–3. Norske Nordhavs-Expedition, Fiske, 1880, p. 18, pl. 1, figs. 5, 6.

Taken at only one station. Two small examples secured.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
310	39° 59′ 16″	70° 18′ 30″	260	2

30. Cottunculus torvus, Goode, new species.

Cottunculus torvus, Goode, Proc. U. S. Nat. Mus., III. p. 479 (name only).

Diagnosis. — Head and body smooth, scaleless, covered with a tough lax skin. The length of the head is nearly one third of the extreme length of the body including the caudal; its greatest height, one fourth of the body without the caudal. The greatest width of the head is twice the length of the maxilla. The distance of the vent from the insertion of the anal equals the length of the maxilla. The eye is close to the dorsal profile. The length of the orbit is about

equal to that of the snout, and is contained about four and a half times in the greatest length of the head. The intermaxillary is long and slender, its length contained slightly more than three times in the distance from the tip of the snout to the insertion of the first dorsal (three and one third times in the length of the head). The maxilla is very slender, except in its posterior third, where it is considerably expanded. The mandible is very stout, posteriorly widened, its length contained nearly two and one third times in that of the head. Teeth in broad villiform bands on the intermaxillary and the mandible. Two short separate similar bands on the vomer. None on the palatines.

Head armed with blunt spines, as in *C. microps.*

The distance of the dorsal from the tip of the snout is nearly equal to one third of the total length, caudal included. It consists of six spines and seventeen rays.

The anal fin is located midway between the tip of the snout and the end of the caudal fin ; it consists of thirteen rays.

The length of the upper pectoral rays is equal to that of the postorbital portions of the head. The pectoral rays diminish rapidly in size, the lowest being exceedingly short. The number of rays is twenty-two. The distance of the ventral from the tip of the snout is one third of the total length without the caudal. The length of the free portion of the ventral equals that of the eye The fin consists of one spine and three rays.

The caudal consists of ten developed rays.

Color light brown, the fins somewhat darker.

This species was first noticed in the Fish Commission collections of 1880, and was mentioned by name in a paper published in that year by Mr. Goode. No description accompanied this name, and the author of it has no excuse to offer for following a practice which is so pernicious and indefensible.

Specimens were obtained as follows : —

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
306	41° 32′ 50″	65° 55′	524	3
343	39° 45′ 50″	70° 55′	732	1
326	33° 42′ 15″	76° 0′ 50″	464	1

SCORPÆNIDÆ.

31. Setarches parmatus, Goode.

Setarches parmatus, Goode, Proc. U. S. Nat. Mus., III. pp. 480, 481, Feb. 16, 1881.

Two specimens, respectively 53 mm. and 52 mm. long, were taken at Station 327, Lat. 34° 0′ 30″, Long. 76° 10′ 30″, at a depth of 178 fathoms. These specimens and the type of the species are the only three examples known.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
327	34° 0′ 30″	76° 10′ 30″	178	2

32. Sebastoplus dactylopterus (De la Roche), Gill.

Scorpæna dactyloptera, De la Roche, Ann. Mus., XIII., pl. 22, fig. 2 (*fide* Günther, Cat. Fish. Brit. Mus., II. p. 99.
Sebastoplus dactylopterus, Gill, MS.

A single young specimen was taken. The U. S. Fish Commission has since secured many young and adult.

Station.	N. Lat.	W. Long.	Fathoms.	Specimen.
311	39° 59′ 30″	70° 12′	143	1

CARANGIDÆ.

33. Caranx amblyrhynchus, Cuv. & Val.?

Caranx amblyrhynchus, Cuv. & Val., Hist. Nat. Poiss., Vol. IX. p. 100, pl. 248.

A single young individual, apparently of this species (D. VIII, i, 27 ; A. II, i, 24 ; V. I, 5 ; L. lat. ca. 39), was taken at Station 324 ; its length is 33 mm. In all probability the fish was caught near the surface, while the trawl was on its way up, and not on the bottom.

Station.	N. Lat.	W. Long.	Fathoms.	Specimen.
324	33° 27′ 20″	75° 53′ 30″	1386	1

BERYCIDÆ.

POROMITRA, new genus.

A single individual, $1\frac{1}{4}$ inches long, was obtained at Station 328, and another one of about the same length is in the collection without locality. The species comes to us in such a dilapidated condition, that it is impossible to make a satisfactory diagnosis of its characters. It seems to differ widely from anything heretofore described. As it is, we simply describe it under a new generic name, and at present shall refer it to *Berycidæ*, to which, as we now view it, it appears to be related.

Provisional Diagnosis. — Body short, compressed, scopeliform, covered with thin cycloid scales. Head very large, nearly half the entire length of the fish to base of caudal, with scales upon cheeks, suboperculum, and probably elsewhere. No barbel. Mouth very large, the lower jaw projecting. Margin of upper jaw composed of a short intermaxillary and a long maxillary. Teeth cardiform, numerous, very small, on the intermaxillaries and mandibles. None discovered on maxillaries, palatines, or vomer. Opercular apparatus complete.

Dorsal fin in the middle of the body, its origin not far behind that of the ventrals, the spinous and soft portions subequal in length. Anal much shorter than dorsal, its middle under the end of the dorsal, or nearly so. Pseudobranchiæ present. Gill openings very wide, separate.

34. Poromitra capito, new species.

The height of the body is two sevenths of its length to base of caudal rays; its width about one half its height. Scales as large as the pupil, with concentric striæ, about twenty-four in the lateral line, and about ten in the transverse series.

Head about two fifths of standard length, somewhat resembling in appearance that of *Alepocephalus Bairdii*. The eye is large, circular, located normally. The length of the upper jaw is three sevenths that of the head; that of the lower jaw about one half. The end of the maxillary is nearly in the perpendicular from the posterior limb of the pupil. The length of the snout is about equal to the least diameter of the eye. The distance from the limb of the preoperculum to the end of the opercular flap is equal to that from the tip of the snout to the posterior margin of the orbit. Teeth as described in generic diagnosis. Dorsal fin inserted midway between tip of snout and origin of middle caudal rays. The fin is mutilated and its outline cannot be determined; it is composed of seven or eight spines and six soft rays, and the length of its base is nearly equal to the height of the body at its insertion.

The anal fin is inserted in the perpendicular from the base of the eighth dorsal ray. It is composed of nine rays, and the length of its base is half that of the dorsal base.

The pectoral is inserted far below the axis of the body, and with a single scale between its axil and the branchial opening. Its length is twice the distance of its insertion from the snout.

The ventral is minute (apparently, and is inserted in advance of the pectoral); it has apparently seven or eight rays.

The caudal is mutilated, but apparently composed of fifteen rays.

Radial formula: D. VII or VIII, 6; A. 9; V. 7 or 8; P. 12; C. 15.

Two examples were secured, — one from an unknown locality. The list follows.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
No locality slip.				1
328	34° 28′ 25″	75° 22′ 50″	1632	1

SYNODONTIDÆ.

BATHYSAURUS, Günther.

Bathysaurus, Günther, Ann. and Mag. Nat Hist., Aug. 1878, p. 181.

35. Bathysaurus Agassizii, new species.

Body elongate, subcylindrical, with depressed head and tapering tail, its greatest height contained seven times in its standard length, and eight times in

the length to tip of upper caudal lobe: its greatest width nine times in standard length; its height at the origin of the anal about half its greatest height; length of caudal peduncle equal to greatest height of body.

Scales irregularly ovate, with the free portion convex, thin, cycloid, leathery, deciduous, those in middle of body with a vertical diameter nearly equal to that of the pupil, those of lateral line with posterior margin truncate. In the lateral line, which extends upon the caudal fin, descending below the median line of the body near the origin of this fin, are seventy-eight specialized scales, larger than those of the body. Between the dorsal fin and the lateral line are about eight rows of scales; between the latter and the anal fin are about the same number.

Head twice as long as the greatest height of the body, strongly depressed, alligator-like, naked except upon the cheeks and a small area on the occiput, with strong nasal and interorbital ridges. The greatest width is somewhat more than half its greatest length, the width of interorbital area nearly equal to half that of head, and one fourth the length of the lower jaw. The length of the snout is equal to twice the horizontal diameter of the eye. The anterior nostrils are situated midway between the tip of the snout and the anterior margin of the orbit. The cleft of the mouth is enormous, its angle posterior to the eye by a distance about equal to the width of the interorbital space. The length of the upper jaw equals one sixth of the standard body length; that of the lower jaw, one fifth. The margin of the upper jaw (formed by the intermaxillary only) is armed with two irregular rows of depressible teeth, some of which are barbed; those in the inner row are much the largest, many of them being two thirds as long as the horizontal diameter of the pupil and twice as long as those in the outer series. The lower jaws are enormously strong, and broad, flattened below, the width measured on the under surface of the head equal to two thirds the width of the broad interorbital space. The lower jaw projects outside of the upper jaw at the sides a distance apparently equal to half its width, and considerably in front; the lower jaws are thickly studded with depressible teeth, many of them, especially the larger inner ones, strongly barbed, those in front claw-like, recurved. On the palatines, three rows of teeth, the middle ones very much enlarged and most of them strongly barbed, — these being the largest of all the teeth. On the tongue a few weaker teeth, and groups of similar teeth upon the vomer.

Gill laminæ, gill rakers, and pseudobranchiæ, as described by Dr. Günther in the diagnosis of the genus.

The dorsal fin contains seventeen rays, and is inserted at a distance from the tip of the snout equal to the length of its own base, and slightly greater than one third of the standard body length. The fourth or longest ray is equal in length to the greatest height of the body. The first ray is a rudiment; the second is nearly half as long as the third; the third slightly shorter than the fourth; after the fourth the rays diminish rapidly in length to the ninth, which is about half as long as the lower jaw, and subsequent to which the diminution is gradual: the last ray is about as long as the first.

There is no adipose dorsal; if ever present, it was obliterated before the specimen came into our possession.

The anal fin contains eleven rays, and is inserted considerably behind the vertical from the termination of the dorsal, — at a distance equal to the horizontal diameter of the eye; the length of its base is equal to half that of the dorsal, the length of its longest ray (the third) equal to that of the eighth of the dorsal.

The caudal is slightly forked, its middle rays two thirds as long as those in the upper lobe, and about equal to the seventh dorsal ray.

The pectoral fin consists of fifteen rays, is inserted under the fourth scale of the lateral line, and at a distance in front of the dorsal equal to half the greatest height of the body. Its length is equal to that of the lower jaw, and the seventh ray is prolonged to a length equal to that of the head, its tip extending to the perpendicular from the twelfth dorsal ray.

The ventral is composed of eight rays, and its base is almost entirely in advance of the perpendicular from the origin of the dorsal: its length equals half that of the head. The two ventrals are far apart.

Radial formula: B. 10 (?); D. 17; A. 11; C. 19; P. 15; A. 8. Scales 8, 78, 8.

Color brownish, the inside of the branchiostegal flap bluish black.

A single specimen, about two feet in total length, a female, full of nearly mature eggs, was taken at a depth of 647 fathoms, at Station 325, in Lat. 33° 35′ 20″ N., Long. 76° W.

MEASUREMENTS.

	Millimeters.
Length to base of caudal	540
Length to end of middle caudal rays	610
Body. Greatest height	76
Greatest width	58
Height at ventrals	76
Least height of tail	25
Head. Greatest length	137
Greatest width	62
Width of interorbital area	27
Length of snout	40
Length of maxillary	89
Length of mandible	108
Diameter of orbit	20
Dorsal. Distance from snout	191
Length of base	171
Length of first ray	5
Length of longest ray (4th)	78
Anal. Distance from snout	380
Length of base	85
Length of longest ray	56

Pectoral. Distance from snout	144
Length	105
Length of prolonged ray	132
Ventral. Distance from snout	175
Length	70
Branchiostegals	X (?)
Dorsal	17
Anal	11
Caudal	19
Pectoral	15
Ventral	8
Number of scales in lateral line	78
Number of transverse rows above lateral line	8
Number of transverse rows below lateral line	8

ALEPOCEPHALIDÆ.

36. Alepocephalus Agassizii, new species.

A single specimen of *Alepocephalus* was obtained at Station 338, in 922 fathoms, Lat. 38° 18′ 40″ N., Long. 73° 18′ 10″ W.

This is the fourth species of the genus which has, to date, come up for description: the first, *A. rostratus*, having been described by Risso from the Mediterranean in 1820; the second, *A. niger*, from north of Australia, at a depth of 1,400 fathoms, obtained by H. M. S. "Challenger," and described by Günther in 1878; the third, *A. Bairdii*, from the Grand Banks of Newfoundland, at a depth of 200 fathoms, described by us in 1879. The former American species having been named in honor of the Director of the U. S. National Museum, we propose to dedicate the one now under consideration to the Curator of the Museum of Comparative Zoölogy, under the name *Alepocephalus Agassizii*.

Diagnosis. — Body slightly less elongate than in *A. Bairdii*, its height being contained very slightly more than five times in its length to origin of middle caudal rays, somewhat compressed, its width being about half its height. The least height of the tail is contained twelve times in the length of the body.

Scales apparently ovate-lanceolate, parchment-like, smaller than in *A. Bairdii:* the specimen is almost denuded of scales, and their arrangement in the drawing has been in part made out from their impressions upon the skin. There are ninety scales in the lateral line, ten between lateral line and origin of dorsal, eleven between same and origin of anal. The base of the dorsal is squamose, the anal slightly so, but probably less than in *A. Bairdii*.

Head somewhat compressed, snout conically elongate, the lower jaw slightly produced. Its length is contained three times in the length of the body (in *A. Bairdii*, 4⅓), slightly exceeding twice the length of the lower jaw, and four times the least height of the tail (in *A. Bairdii*, less than three). Width

of head slightly less than length of operculum, and $9\frac{1}{2}$ times in length of body (12 in *A. Bairdii*).

Length of snout half that of mandible, which is one sixth of total length ($\frac{1}{9}$ in *A. Bairdii*). Diameter of orbit in total length of body $10\frac{1}{2}$ times (18 in *A. Bairdii*), $3\frac{1}{2}$ in head (about $4\frac{1}{3}$ in *A. Bairdii*).

The insertion of the dorsal is immediately above the vent; the distance of its origin from the base of middle caudal rays equal to one third of distance from same to anterior margin of orbit, and at a distance from the snout much greater than two thirds the total length of body (about equal in *A. Bairdii*). The length of its base is equal to one eighth of total length.

The origin of the anal is under the second ray of the dorsal; its length of base is slightly more than one seventh of the body length, and is equal to the height of the body at the vent.

The ends of the dorsal, anal, and caudal rays are broken off in the specimen before us.

Distance of pectoral from snout, equal to $\frac{1}{3}$ of the body length (slightly more than $\frac{1}{4}$ in *A. Bairdii*) and $4\frac{1}{2}$ times least height of tail (3 in *A. Bairdii*). Its length equal to the diameter of orbit and contained $10\frac{1}{2}$ times in total length (10 in *A. Bairdii*). The origin of the pectoral is close behind the end of the opercular flap, while in *A. Bairdii* it is separated therefrom by four rows of scales.

Distance of ventral from snout considerably less than twice the length of the head. Its length, probably, about one sixth that of the head.

Radial formula: D. 15; A. 17; C. 19; P. 11; V. 1, 5?

L. lat. 90.

Dentition as in *A. Bairdii*.

Color dark, head and fins nearly black.

Station.	N. Lat.	W. Long.	Fathoms.	Specimen.
338	38° 18′ 40″	73° 18′ 10″	922	1

HALOSAURIDÆ.

37. Halosaurus macrochir, Günther.

Halosaurus macrochir, Günther, Ann. and Mag. Nat. Hist., 5th Ser., II., 1878, p. 251.

H. macrochir was described by Dr. Günther from specimens obtained by H. M. S. "Challenger," in the Atlantic, at a depth of 1090 fathoms, and midway between the Cape of Good Hope and Kerguelen's Land, at a depth of 1375 fathoms.

Specimens were obtained by the "Blake" at the following stations: —

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
308	41° 24′ 25″	65° 35′ 30″	1242	1
325	33° 35′ 20″	76°	647	5

STOMIATIDÆ.

38. Stomias ferox, Reinhardt.

Stomias ferox, Reinhardt, Vid. Selsk. Nat. og Math., Afhandl. X. p. lxxviii.

A single specimen was obtained at each of the two following stations : —

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
309	40° 11′ 40″	68° 22′	304	1
306	41° 32′ 50″	65° 55′	524	1

STERNOPTYCHIDÆ.

39. Sternoptyx diaphana, Hermann.

Sternoptyx diaphana, Hermann, Naturforscher, XVI. p. 781, p. 8, Taf. I. figs. 1 and 2; XVII. p. 249 ("Copied by Walbaum, Artedi, III., Vol. 1. figs. 1 and 2, and by Schneider, p. 494, Pl. XXXV."). Cuvier, Règne Animal, 2d ed., Pl. XIII. fig. 1. Cuvier & Valenciennes, Hist. Nat. Poiss., XXII. p. 415. Günther, Cat. Fish. Brit. Mus., V. p. 387 (no specimens).

Specimens were caught at the stations mentioned below.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
323	33° 19′	76° 12′ 30″	457	1
316	32° 7′	78° 37′ 30″	229	1

40. Argyropelecus hemigymnus, Cocco.

Argyropelecus hemigymnus, Cocco, Giorn. Sc. Sic. 1829, fasc. 77, p. 146. Bonaparte, Faun. Ital. Pesc. Cuv. & Val., Hist. Nat. Poiss., XXII. p. 398. Günther, Cat. Fish. Brit. Mus., V. p. 385.

Sternoptyx hemigymnus, Valenciennes, in Cuvier, Règne Animal, Ill. Poiss., Pl. 103, fig. 3.

Sternoptyx mediterranea, Cocco, Giorni il Faro, 1838, IV. p. 7, fig. 2. Bonaparte, Faun. Ital. Pesc., Fig.

This species was obtained at Station 315, at a depth of 225 fathoms. It was also obtained by the steamer "Fish Hawk," August 18, 1882, at Station 1112 (Lat. 39° 56′ N., Long. 70° 35′ W., 245 fathoms), and was seen by Dr. Bean on the same vessel in 1880.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
315	32° 18′ 40″	78° 43′	225	2

CYCLOTHONE, new genus.

Numerous small specimens, in very bad condition, were received, belonging to an undescribed genus of the family *Sternoptychidæ*, or of some closely related family not yet defined.

Diagnosis. — Body long, somewhat compressed, apparently naked, covered with dark pigment-cells, there being no scales. A series of luminous spots along the lower sides of the body. Head conical, cleft of mouth very wide, oblique, the lower jaw strongly projecting. The maxilla is long and slender, anteriorly curved strongly upward, its outline sickle-shaped, closely connected with the short intermaxillary. Maxillary and intermaxillary with a single series of rather large acicular teeth, about every fourth one in the maxilla longer than the average. Lower jaw with teeth apparently uniform in size, raking forward, and with a few canines in front. A small patch of minute teeth upon the head of the vomer. Palate smooth. Eye moderate, inconspicuous, apparently covered with opaque membrane, causing a dull appearance. Gill opening very wide, the branchiostegal membrane free from the isthmus. Gill rakers long and slender, moderately numerous, more than twice as numerous below as above the angle.

Pseudobranchiæ absent (branchiostegals not clearly made out, apparently seven, eight, or nine). No air-bladder. All the fins well developed : the anal large : dorsal and anal fins entirely on the posterior half of the body : no adipose dorsal : caudal forked.

41. Cyclothone lusca, new species.

Body elongate, its greatest height contained $7\frac{2}{3}$ times in its length to base of middle caudal rays, its width being less than two thirds of its height. Its height at the ventrals is contained $8\frac{1}{3}$ times in standard length : the least height of tail is half that of the body at the ventrals.

Head length contained $4\frac{2}{3}$ times in body length, its width about one third of its length. The intermaxillary is very short, extending to vertical from posterior limb of anterior nostril. The maxillary is very strongly curved downward, and has a short knob at its anterior extremity, not visible without dissection. The maxillary extends backward to a distance from the tip of the snout equal to the length of the head without the snout. The peculiar arrangement of the teeth is described above in the generic diagnosis. Most of those in the maxillary are inclined strongly forward.

The long lower jaw, with the exception of the projecting tip, is included within the upper jaw : its length is equal to the distance from the anterior nostril to the end of the head.

Eye circular, close to the profile, the interorbital area being very narrow. Its length is equal to that of the snout, and contained seven times in the length of the head.

Dorsal fin inserted at a distance from the tip of the snout equal to three

times the length of the lower jaw, its base being as long as the head ; the first ray is minute, and about two thirds as long as the eye ; the second ray is about two thirds the length of the base of the fin, and the subsequent rays rapidly and uniformly decrease in length to the last, which is about twice as long as the first. All the rays except the first are bifid.

The anal fin is inserted under the second ray of the dorsal : its base is half as long again as that of the dorsal, and nearly one third as long as the body of the fish : its outline resembles that of the dorsal, though slightly emarginate, its longest ray a little longer than the longest of the dorsal, and half as long as the base of the fin. All the rays except the first are bifid.

Caudal forked, its middle rays less than half as long as the outer rays, equal in length to least height of caudal peduncle.

Pectoral inserted under the tip of the opercular flap, its length equal to the greatest height of the body.

Ventral inserted at a distance from the snout equal to twice the length of the head, its length slightly exceeding that of the pectoral, and contained seven times in the standard body length.

Radial formula : B. VII to IX ; D. I, 11 ; A. I, 16 ; C. 17 ; P. 10 ; V. 5.

Color blackish brown, the luminous pores inconspicuous.

Specimens were obtained at the following stations.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
330	31° 41′	74° 35′	1047	5
323	33° 19′	76° 12′ 30″	457	37
328	34° 28′ 25″	75° 22′ 50″	1632	13
324	33° 27′ 20″	75° 53′ 30″	1386	20

SCOPELIDÆ.

42. Scopelus Mülleri (Gmel.), Collett.

Salmo Mülleri, Gmelin's Linnæus, Systema Naturæ, I., 1788, p. 1378.

Scopelus glacialis, Reinhardt, Oversigt Kgl. D. Vid. Selsk. Nat. Math. Aph. VI. p. ex., Copenhagen, 1837.

Scopelus Mülleri, Collett, Norges Fiske Tillaegsh. til. Forh. Vid. Selsk., Christiania, 1874, p. 152. Norske Nordhavs-Expedition, 1876–1878, Fiske, 1880, p. 158.

This species, known hitherto only from the coast of Greenland and the northern shores of Norway, has been frequently taken during the past two years, by the U. S. Fish Commission, off the southern shores of New England, and was also obtained by the "Blake" at the stations mentioned below.

The following specimens, all in bad condition, were obtained.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens
303	41° 34′ 30″	65° 54′ 30″	306	1
334	38° 20′ 30″	73° 26′ 40″	395	3
309	40° 11′ 40″	68° 22′	304	1
329	34° 39′ 40″	75° 14′ 40″	603	3

MICROSTOMIDÆ.

43. Hyphalonedrus chalybeius, Goode.

Hyphalonedrus chalybeius, Goode, Proc. U. S. Nat. Mus., III. pp. 484, 485, Feb. 16, 1881.

This species was found at the following stations.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
321	32° 43′ 25″	77° 20′ 30″	233	1
316	32° 7′	78° 37′ 30″	229	1
327	34° 0′ 30″	76° 10′ 30″	178	5 bad

SACCOPHARYNGIDÆ.

44. Saccopharynx flagellum, Mitchill.

Saccopharynx flagellum, Mitchill, Ann. Lyc. New York, I., 1824, p. 82.

A single badly mutilated example was secured.

Station.	N. Lat.	W. Long.	Fathoms.	Specimen.
331	35° 44′ 40″	74° 40′ 20″	898	1

SYNAPHOBRANCHIDÆ.

45. Synaphobranchus pinnatus (Gronow), Gthr.

Muræna pinnata, Gronow, Syst. ed. Gray, p. 19 (*fide* Günther).
Synaphobranchus pinnatus, Günther, Cat. Fish. Brit. Mus., VIII. p. 23.

Numerous specimens were obtained, as will be seen by referring to the following list.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
309	38° 18′ 40″	73° 18′ 10″	304	35
Unknown.				4
303	41° 34′ 30″	65° 54′ 30″	306	12
312	39° 50′ 45″	70° 11′	466	8
325	33° 35′ 20″	76°	647	12
337	38° 20′ 8″	73° 23′ 20″	740	2
326	33° 42′ 15″	76° 0′ 50″	464	6
Unknown.				1
329	34° 39′ 40″	75° 14′ 40″	603	4

MURÆNESOCIDÆ.

46. Nettastoma procerum, new species.

Two specimens of a species of *Nettastoma* were obtained at Station 325, Lat. 33° 35′ 20″, Long. 76°, at a depth of 647 fathoms. Another (mutilated), something over 190 mm. long, was taken at Station 327. The species is in many respects closely allied to the *Nettastoma melanurum* of the Mediterranean, but appears to differ from it in the greater length of the tail, the much smaller teeth, and in the presence of a filamentous nasal tip.

Description. — Body anguilliform, very elongate, compressed, — posteriorly greatly so, — and tapering to a very slender attenuate point. Its greatest height is contained nearly four times in the distance from the gill opening to the tip of the lower jaw, and equals half the length of the snout. Head slender, conical : jaws somewhat depressed : the upper jaw heavier and thicker, and projecting beyond the lower a distance equal to the diameter of the eye. Length of snout equals the distance from the posterior margin of the orbit to the gill opening : the cleft of the mouth extends far behind the eye to a distance equal to the diameter of the eye. On each side of the upper jaw, and in advance of the eye, are twelve pores ; behind each eye are three pores, while on the median line, on the top of the upper jaw, are several pores posteriorly arranged in pairs, of which there are four, the ultimate pair being between the posterior nostrils. There is also a pair of pores upon the nape, connecting the postorbital rows, and seventeen on each side of the mandible. The mandibulary series is continued by another series extending over the cheeks and nape. The snout is provided with a slender, filamentous tip, whose length is equal to twice the diameter of the eye. The tongue is apparently absent in the specimens examined by us. The teeth are arranged as in *N. melanurum*, but exceedingly small, and much less conspicuous than in the figures of Kaup and Risso.

Dorsal fin commences above the gill opening.

The anal fin is inserted under the 73d dorsal ray at a distance from the snout equal to $3\frac{2}{3}$ times the length of the head. The tail is twice as long as the body with the head included. The total length of the specimen is 727 millimeters, including the nasal tip, which measures 7 mm.

Lateral line highly specialized, with numerous pores, corresponding in general character to those upon the head, and arranged in a deep furrow, their distances apart being about the same as in the case of those upon the head. Height of dorsal and anal fins about equal to half the height of body.

Color apparently brownish ; peritoneum black.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
325	33° 35′ 20″	76°	647	2
327	34° 0′ 30″	76° 10′ 30″	178	1

NEMICHTHYIDÆ.

47. Nemichthys scolopaceus, Richardson.

Nemichythys scolopaceus, Richardson, Voyage Samarang, Fishes, p. 25, Pl. X. figs. 1–3 (*fide* Günther, Cat. Fish. Brit. Mus., VIII. p. 21).

Five individuals in all were taken at the following stations.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
303	41° 34′ 30″	65° 54′ 30″	306	1
309	40° 11′ 40″	68° 22′	304	1
306	41° 32′ 50″	65° 55′	524	1
330	31° 41′	74° 35′	1047	1
338	38° 18′ 40″	73° 18′ 10″	922	1

LEPTOCEPHALIDÆ.

48. Leptocephalus sp. (Perhaps larva of *Synaphobranchus*.)

A single individual, measuring 175 millimeters in length, was secured at the station following.

Station.	N. Lat.	W. Long.	Fathoms.	Specimen.
315	32° 18′ 20″	78° 43′	225	1

RAIIDÆ.

49. Raia plutonia, Garman.

Raia plutonia, Garman, Bull. Mus. Comp. Zoöl. Cambridge, Vol. VIII. No. 11, p. 236, March, 1881.

Not in the collection studied by us. The species was taken at Stations 316, 317, and 321.

50. Raia ornata, Garman.

Raia ornata, Garman, Bull. Mus. Comp. Zoöl. Cambridge, Vol. VIII. No. 11, pp. 235, 236, March, 1881.

Not seen by us. Said to be a variety of *R. Ackleyi*, by Mr. Garman. Three specimens were taken at Station 314.

SCYLLIIDÆ.

51. Scyllium retiferum, Garman.

Scyllium retiferum, Garman, *op. cit.*, p. 233.

Not studied by us. One specimen was in the "Blake" collection from Station 335. The U. S. Fish Commission has since obtained several examples.

MYXINIDÆ.

52. Myxine glutinosa, Linn.

Specimens were taken at the following stations.

Station.	N. Lat.	W. Long.	Fathoms.	Specimens.
309	40° 11′ 40″	68° 22′	304	1
306	41° 32′ 50″	65° 55′	524	1
327	34° 0′ 30″	76° 10′ 30″	178	1

U. S. National Museum, Washington, D. C.,
February 22, 1883.

No. 6. — *Reports on the Results of Dredging, under the Supervision of* Alexander Agassiz, *in the Caribbean Sea in* 1878–79, *and along the Atlantic Coast of the United States during the Summer of* 1880, *by the U. S. Coast Survey Steamer "Blake,"* Commander J. R. Bartlett, U. S. N., Commanding.*

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XX.

Report on the Ophiuroidea. By Theodore Lyman.

The West Indies are the hotbed of Echinodermata. Out of less than six hundred living species of Ophiuroidea now known, about one hundred and fifty-five, or more than a quarter, are from that region; and for the round Echinoderms the proportion is even larger. Beginning at low-water mark, this fauna descends to 1,568 fathoms; and, having its centre in the Caribbean Sea and the Gulf of Mexico, it sends branches northward at least as far as South Carolina, and southward to Brazil. In the present state of knowledge, it seems a well-marked fauna, containing a great number of distinctive forms, although there occasionally occur species from other marine regions, such as *Ophioscolex glacialis* and *Astronyx Loveni*. This appearance of limitation may come in part from the special investigations in this area; for it is to be borne in mind that the U. S. ships "Corwin," "Bibb," "Hassler," and "Blake" have dredged in about 570 stations, chiefly along the line of the Antilles, and from the Dry Tortugas to Cape Florida. In addition to these, some hauls were made by Dr. William Stimpson, and by the naturalists of the "Challenger."

Nearly all known genera of Ophiuroidea are there found, the most notable exceptions being Ophioplocus, Ophioplinthus, Ophiopholis, Ophiarachna, Ophiarthrum, Ophiomastix, and Trichaster.

Among Ophiurans, as in other animals, we find that certain genera

* In this paper are included six new species from the dredgings of the "Porcupine" and the "Challenger," which are published by permission of the Lords Commissioners of the Treasury.

are very rich in species; such are Ophioglypha, Amphiura, Ophiacantha, and Ophiothrix, which contain two thirds as many species as do all the remaining sixty-eight genera in the family. A peculiar structure does not necessarily entail abundance of species, for the Astrophyton-like Ophiurans (e. g. Ophiomyxa) have few species.

There are included in this paper three unpublished species from the dredgings of H. B. M. ship "Porcupine," — *Ophiochiton tenuispinus*, *Ophiomyxa serpentaria*, and *Ophiobyrsa hystricis;* and from the "Challenger" expedition there are one genus and three species whose originals were found among the collections of the late Sir Wyville Thomson. They are *Ophiocopa spatula*, *Ophiacantha scolopendrica*, and *Ophiomastus texturatus*. All the rest are from the "Blake" dredgings.

The following list of species will show all new information as to the depths at which they occur, and will give some notion of their frequency, by the number of stations at which they are found.

Ophiopæpale Goesiana. Up to 38 fathoms.

Ophiozona nivea. From twenty-six stations, and in large numbers. Up to 50 fathoms.

Ophiozona tessellata. From seventeen stations. 60–300 fathoms.

Ophiozona impressa. Down to 300 fathoms.

Ophiozona antillarum. Ten stations. 94–508 fathoms.

Ophioglypha Sarsii. Found as far south as 35° 45′ 30″ N., and down to 306 fathoms.

Ophioglypha lepida. Ten stations.

Ophioglypha falcifera. Twelve stations. 200–508 fathoms.

Ophioglypha variabilis. Twenty-six stations. Up to 175 fathoms.

Ophiomusium eburneum. Twenty-two stations. 95–390 fathoms.

Ophiomusium Lymani was dredged at only nine stations, but in such quantities that Mr. Agassiz was forced to throw away a large part. These hauls illustrate the abundance of animal life at great depths; for the shallowest station was 810 fathoms.

Ophiomusium validum. The great number of stations (thirty-two) at which it was dredged show its frequent occurrence, as well as its variation in depth, now known to run from 60 to 1568 fathoms.

Ophiomusium testudo. Sixteen stations. 69–508 fathoms.

Ophiomusium planum. Up to 300 fathoms.

Ophiomusium acuferum. This humble species, described by me in 1875 from the "Hassler" dredgings, proves to be the most widely spread in that fauna. It also inhabits very diverse depths, and must accommodate itself to temperatures varying from 78° to 39° Fah. Strangely enough, it has not yet been found outside the West Indian limits. Thirty-five stations. 27–1030 fathoms.

Ophiomusium serratum. Thirteen stations. 124–1097 fathoms.
Ophiomastus secundus. Thirteen stations. 60–1131 fathoms.
Ophiopyren longispinus. Eighteen stations. 60–625 fathoms.
Ophioconis miliaria. Up to 163 fathoms.
Ophiochœta mixta. Down to 572 fathoms.
Ophiactis Mülleri var. **quinqueradia.** 27–338 fathoms.
Amphiura duplicata, like *Ophioglypha variabilis* and *Ophiomusium acuferum,* is plentiful, and is found over a great range of depth. Thirty-four stations.
Amphiura Otteri. There is some question about the distinction of those species that stand near the old *A. Chiajei.* I believe, however, that Ljungman's species was found by the "Blake" from 41° 32′ 50″ N. to the island of Grenada on the south, and from 175 to 576 fathoms.
Amphiura tumida. Up to 94 fathoms.
Amphiura lunaris. Up to 424 fathoms.
Amphiura cuneata. 159–370 fathoms.
Amphiura Stimpsoni. Down to 69 fathoms.
Ophionereis reticulata. Down to 94 fathoms.
Ophioplax Ljungmani. Eleven stations. Down to 175 fathoms.
Ophiostigma isacanthum. Down to 122 fathoms.
Ophiacantha bidentata. From as far south as 33° 27′ 20″ N.
Ophiacantha hirsuta. Twelve stations. 82–955 fathoms.
Ophiacantha sertata. Ten stations. 150–411 fathoms.
Ophiacantha vepratica. Seven stations. Up to 291 fathoms.
Ophiacantha scutata. Nine stations. 124–338 fathoms.
Ophiacantha echinulata. Up to 303 fathoms.
Ophiacantha pentacrinus. Twenty-four stations. Down to 625 fathoms.
Ophiacantha stellata. Twelve stations. 56–262 fathoms.
Ophiacantha aspera. Twelve stations. 73–262 fathoms.
Ophiomitra valida. Twenty-four stations. Down to 1105 fathoms. Another abundant species, of great range in depth.
Ophiocamax hystrix. Fifteen stations. 114–300 fathoms.
Ophiothamnus vicarius. Six stations. Down to 611 fathoms.
Ophiothrix Suensonii. Twenty-one stations. Down to 262 fathoms.
Ophiothrix angulata. Fourteen stations. Down to 262 fathoms.
Ophioscolex tropicus. 103–502 fathoms.
Ophiomyces mirabilis. Down to 422 fathoms.
Ophiomyces frutectosus. Down to 288 fathoms.
Ophiochondrus convolutus. Eleven stations. Up to 88 fathoms.
Sigsbeia murrhina. Twenty-one stations.
Gorgonocephalus mucronatus. Down to 288 fathoms.
Astrogomphus vallatus. 114–337 fathoms.
Astroporpa annulata. Sixteen stations. Down to 163 fathoms.
Astrochele Lymani. Down to 980 fathoms.
Astroschema arenosum. Eight stations. Up to 120 fathoms.

Astroschema læve. Sixteen stations. 56–262 fathoms.
Astroschema oligactes. Seventeen stations.
Astroschema tenue. Four stations. 88–124 fathoms.
Ophiocreas lumbricus. Seven stations. Down to 580 fathoms.
Ophiocreas œdipus. Down to 580 fathoms.
Astronyx Loveni (young). Down to 980 fathoms.

Ophiura Elaps ? Lym.

These fine specimens, of which the largest had a disk of 28 mm. and arms of about 200 mm., only differed from Lütken's description (Addit. ad Hist. Oph., Pt. II. p. 93) in having six or seven, instead of seven or eight arm-spines, of which the upper ones were longest.

Station (Bartlett) 29, 21° 23′ 19″ N., 82° 54′ 42″ W., 300 fathoms. Station 157, Montserrat, 120 fathoms. Station 241, Grenadines, 163 fathoms.

Ophiura brevispina Lym.

Station 142, Flannegan Passage, 27 fathoms. Station 152, St. Kitts, 122 fathoms. Station 285, Barbados, 13–40 fathoms.

Ophiura cinerea Lym.

Station 132, Santa Cruz, 115 fathoms. Station 276, Barbados, 94 fathoms. Station 278, Barbados, 69 fathoms.

Pectinura tessellata sp. nov.

Plate III. Figs. 1-3.

Special Marks. — One tentacle-scale : four or five short arm-spines. Under arm-plates narrow and rounded. Granulation of disk continuous above, but with naked patches below.

Description of an Individual (Station 130). — Diameter of disk 17.5 mm. Length of arm about 95 mm. Width of arm close to disk 4 mm. Sixteen stout mouth-papillæ to each angle, whereof the one next the outermost is much the widest and stoutest, while those within grow gradually narrower and more peg-like. Four flat, stout, short teeth, the lowest one of which is sometimes cleft. Mouth-shields wide heart-shape with a rounded point within. The supplementary shield lies just outside and forms one of a number of thick naked plates which partly cover the lower interbrachial space. Side mouth-shields three-cornered and very small, lying next the outer corners of the mouth-shields. Under arm-plates occupying less than half the width of the arm ; as long as broad ; bounded without by a curve, within by a truncated

angle, and on the sides by a re-entering curve. Side arm-plates occupying about two thirds of the height of the arm, and having a cleanly curved outer side. Upper arm-plates arched (but not so strongly as in *O. hcros*), wider without than within, and having straight outer and inner sides. Disk angular, closely and evenly covered above, except the radial shields, with a fine granulation having about six grains in the length of 1 mm. Interbrachial spaces below have a reticulated look, from the numerous bare plates among the granulation. Radial shields wide oval; length to breadth, 2.3 : 1.8. Genital opening long, extending from mouth-shield nearly to edge of disk. Four or five small, peg-like, even, spaced arm-spines, a little more than half the length of a joint. One stout, round tentacle-scale.

Station 130, near Frederickstadt, 451 fathoms, 1 specimen.

This species is well distinguished from *P. heros* and *P. lacertosa* by a flatter arm, four or five peg-like spaced arm-spines, and naked plates in the lower interbrachial space.

Pectinura lacertosa sp. nov.

Plate III. Figs. 4-6.

Special Marks. — Three arm-spines about as long as a joint and standing low down on side of arm. Indentations, but no pores, between the first four or five lower arm-plates. Arms short; only three and a half or four times the diameter of the disk. One large, round tentacle-scale.

Description of an Individual (Station 258). — Diameter of disk 35 mm. Length of arm about 135 mm. Width of arm close to disk, without spines, 6 mm. About twenty mouth-papillæ to each angle, whereof the two or three outer ones are wide and squarish, while those within are sharp and peg-like. The two lowest teeth are replaced by similar papillæ. Mouth-shields short heart-shape with a rounded angle within; length to breadth, 4 : 5. There are sometimes one or more large scales, or supplementary pieces, just outside. Side mouth-shields very small and nearly obliterated. Under arm-plates about as wide as long, bounded without by a curve, within by a truncated angle, and on the sides by a re-entering curve. Side arm-plates low, occupying only about one half the height of the arm, and meeting neither above nor below. Upper arm-plates highly arched, closely overlapping, with outer and inner edges nearly straight; each is usually broken in two pieces. Disk angular, closely and evenly covered with very fine granules, 7 or 8 in the length of 1 mm., except the radial shields and sometimes a small plate on the margin. Radial shields egg-shaped, somewhat longer than broad with outer and inner ends much rounded; length to breadth, 4 : 2.5. Lower interbrachial space covered by a similar granulation, extending even to the mouth-angle. There are none on the mouth-shields, outside which are one or more thick, partially naked scales, representing the supplementary shield. Genital opening long, extending from mouth-shield nearly to margin of disk. Three, some-

times four, stout, rounded, tapering arm-spines, not quite as long as a joint. One round, thick tentacle-scale. Color in alcohol, nearly white.

Station 258, near Grenada, 159 fathoms, 1 specimen.

This species is very near *P. heros*, dredged in 900 fathoms by the "Challenger," near New Guinea, but differs in its longer and differently placed arm-spines, and in the indentations between the basal under arm-plates.

Pectinura angulata sp. nov.

Plate III. Figs. 7-9.

Special Marks. — Disk with thin scales covered by a fine granulation. Nine arm-spines, of which the lowest is longest and broad and flat. Pores only between the first three under arm-plates.

Description of an Individual (Station 134). — Diameter of disk 27 mm. Width of arm close to disk 5.5 mm. About twenty mouth-papillæ to each angle, of which the two or three outer ones are much the widest and are squarish, while those within are spiniform. The lowest of the five broad, flat teeth is split in two, and there are sometimes one or two additional papillæ at the apex of the mouth-angle. Under arm-plates within the disk wider than long, bounded without by a curve, within by a wide much-truncated angle, and on the sides by re-entering curves. Further out they are as long as broad and nearly octagonal. They are stout but not swollen, and there are pairs of pores between the first three. Side arm-plates with a gently curved outer edge, and occupying nearly the whole height of the arm. Upper arm-plates smooth, nearly flat, regular, with straight outer and inner sides, and the outer corners rounded. They occupy nearly the whole upper surface. Length to breadth, 1.5 : 4. Mouth-shields short heart-shape, with a rounded angle within. Length to breadth, 4 : 5.5. Supplementary shields small, and swollen ; length to breadth, 1 : 1.3. Side mouth-shields reduced to a little plate, at the outer corner of the mouth-shield. Disk angular, and covered by a close, fine granulation, which is easily rubbed off, as is shown in the figure. There are about seven grains in the length of 1 mm. Radial shields naked, of a narrow oval shape and pointed within ; length to breadth, 4 : 2. The scale-coat of the disk is of thin delicate scales about 1 mm. in length. Arm-spines nine, the eight uppermost slender, pointed, and flattened, and about three fourths the length of a joint. The lowest one is much wider, blunt, and longer than a joint. Two tentacle-scales of a short spatula-shape : the upper one covering the base of the lowest arm-spine. On the first tentacle-pore there are usually two supplementary scales placed just outside the pore. Color in alcohol, nearly white.

Station 134, near Santa Cruz, 248 fathoms, 1 specimen. Station 232, St. Vincent, 88 fathoms.

This species is nearest *P. rigida*, from which it is distinguished by a shorter under arm-spine, larger radial shields, coarser disk-scales, and pores between the under arm-plates extending only to three joints.

In other specimens the granulation was uninterrupted over the disk, except small spots at the radial shields. The supplementary mouth-shield is often very small, and ill marked.

Ophiopæpale Goesiana Ljn.

Station 101, Morro Light, 175–250 fathoms. Station 132, Santa Cruz, 115 fathoms (young). Station 127, Santa Cruz, 38 fathoms. Station 155, Montserrat, 88 fathoms. Station 157, Montserrat, 120 fathoms. Station 253, Grenada, 92 fathoms. Station 269, St. Vincent, 124 fathoms. Station 272, Barbados, 76 fathoms. Station 293, Barbados, 82 fathoms. Station 297, Barbados, 123 fathoms.

Ophiozona marmorea sp. nov.

Plate III. Figs. 10-12.

Special Marks. — Arms very stout and short (two and a half times diameter of disk), with strongly projecting side arm-plates and small sunken upper arm-plates. Side mouth-shields much swollen. Lower interbrachial spaces with scattered grains.

Description of an Individual (Station 164). — Diameter of disk 8 mm. Length of arm 19 mm. Width of arm next disk 2.3 mm. Five short, blunt, crowded angular papillæ to each mouth-angle, and, at the apex, the lowest of the short teeth ; the outer papillæ are largest. Mouth-shields small, much larger than broad, five-sided with a curve without and an angle within ; length to breadth, 1.2 : .8. Side mouth-shields larger than mouth-shields proper ; much swollen, rudely triangular, and meeting fully within. First under arm-plate small and pentagonal, with a long angle inward ; those beyond are much larger, but still cover only about a third of the arm's width ; they are much wider without than within, with a sharp peak on the outer corners, and re-entering curves on the lateral sides ; length to breadth, 1.2 : .8. Side arm-plates large and swollen, but meeting neither above nor below. Upper arm-plates small and sunken, fan-shaped, with a truncated angle inward ; they cover not more than a third of the upper surface. Disk covered by large, thick, swollen rounded plates, with a central rosette of primaries and a radiating row of three in each interbrachial space. Radial shields longer than broad, rounded and swollen, separated by a wedge of two or three scales ; length to breadth, 2.3 : 2 ; between their outer ends and the arm is a row of narrow plates. Interbrachial spaces below covered on either side by stout genital scales, and in the middle by a single row of two or three swollen plates ; they bear a scattered granulation. Genital openings long, extending from sides of radial shields to margin of disk. Four short, stout, tapering, blunt, equal arm-spines, about two thirds as long as a joint. Two large oval tentacle-scales to each pore. Color in alcohol, white.

Station 101, 175–250 fathoms, 1 specimen. Station 134, 248 fathoms, 3

specimens. Station 158, 148 fathoms, 1 specimen. Station 164, Guadeloupe, 150 fathoms, 11 specimens. Station 220, 160 fathoms, 1 specimen. Station 224, 114 fathoms, 1 specimen.

O. marmorea is nearest *O. nivea*, from which it differs in its swollen disk-plates, side arm-plate and side mouth-shields, its smaller upper arm-plates, and shorter arms, and in granulation on the lower interbrachial space.

Ophiozona clypeata sp. nov.

Plate III. Figs. 13-15.

Special Marks. — Eleven close-set, lumpy mouth-papillæ to each angle. Side mouth-shields large and wide. Three moderately stout arm-spines, about as long as a joint.

Description of an Individual (Station 219). — Diameter of disk 10 mm. Length of arm 65 mm. Width of arm near disk 2 mm. Eleven short, lumpy, crowded mouth-papillæ to each angle, whereof the one next the outermost is widest. Mouth-shields blunt spear-head shape, with the point inward; length to breadth, 1.5 : 1. Side mouth-shields rather wide and fully meeting within. Under arm-plates thick, but not ridged, much wider without than within where they are bounded by a wide truncated angle, while the outer is a broken curve and the lateral sides are re-entering curves. Side arm-plates short and stout, with a low spine-ridge. Upper arm-plates twice as broad as long, and much wider without than within. Disk round and flat, covered with distinct rounded slightly swollen overlapping scales, among which the primaries are conspicuous by their greater size. Radial shields short, oval; length to breadth, 1.2 : 8. In the interbrachial spaces below, the scales are of uniform size, about three in the length of 1 mm. Genital openings long, extending from outer corners of the mouth-shield quite to margin of disk. Three moderately stout, cylindrical, tapering, blunt arm-spines; the two upper ones as long as a joint, the lowest a little longer. Two rudely semicircular tentacle-scales on the side arm-plate, whereof the one next the under arm-plate is smaller. Color in alcohol, nearly white.

Station 219, off Saint Lucia, 151 fathoms, 1 specimen. Station 232, St. Vincent, 88 fathoms.

By its smaller disk-scales and longer and more pliable arms this species connects the large-scaled and stiff-armed Ophiozonæ with the type *O. impressa*. It shows, too, the affinity of the genus to Ophiochiton through *O. lentus*.

Ophiozona nivea Lym.

Station 129, Santa Cruz, 314 fathoms. Station 145, St. Kitts, 270 fathoms. Station 146, St. Kitts, 245 fathoms. Station 147. St. Kitts, 250 fathoms. Station 148, St. Kitts, 208 fathoms. Station 154, Montserrat, 298 fathoms. Station 155, Montserrat, 88 fathoms. Station 172, Guadeloupe, 62–180 fath-

oms. Station 183, Dominica, 252 fathoms. Station 208, Martinique, 213 fathoms. Station 209, Martinique, 189 fathoms. Station 210, Martinique, 191 fathoms. Station 215, St. Lucia, 226 fathoms. Station 216, St. Lucia, 154 fathoms. Station 218, St. Lucia, 164 fathoms. Station 219, St Lucia, 151 fathoms. Station 224, St. Vincent, 114 fathoms. Station 238, Grenadines, 127 fathoms. Station 241, Grenadines, 163 fathoms. Station 258, Grenada, 159 fathoms. Station 273, Barbados, 103 fathoms. Station 274, Barbados, 209 fathoms. Station 280, Barbados, 221 fathoms. Station 291, Barbados, 200 fathoms. Station 292, Barbados, 56 fathoms. Station 294, Barbados, 137 fathoms. Bartlett, Station 29, 21° 23′ 19″ N., 82° 54′ 42″ W., 300 fathoms, sp. ?

Ophiozona tessellata Lym.

Station 134, Santa Cruz, 248 fathoms. Station 149, St. Kitts, 60–150 fathoms. Station 156, Montserrat, 88 fathoms. Station 157, Montserrat, 120 fathoms. Station 158, Montserrat, 148 fathoms. Station 166, Guadeloupe, 150 fathoms. Station 206, Martinique, 170 fathoms. Station 208, Martinique, 213 fathoms. Station 220, St. Lucia, 116 fathoms. Station 231, St. Vincent, 95 fathoms. Station 238, Grenadines, 127 fathoms. Station 273, Barbados, 103 fathoms. Station 282, Barbados, 154 fathoms. Station 290, Barbados, 73 fathoms. Station 297, Barbados, 123 fathoms. Station 299, Barbados, 140 fathoms. Bartlett, Station 29, 21° 23′ 19″ N., 82° 54′ 42″ W., 300 fathoms.

Ophiozona impressa Lym.

Station 132, Santa Cruz, 115 fathoms. Station 272, Barbados, 76 fathoms. Station 276, Barbados, 94 fathoms. Station 278, Barbados, 69 fathoms. Station 298, Barbados, 120 fathoms. Bartlett, Station 29, 21° 23′ 19″ N., 82° 54′ 42″ W., 300 fathoms.

Ophiozona antillarum Lym.

Station 136, Santa Cruz, 508 fathoms. Station 204, Martinique, 476 fathoms. Station 205, Martinique, 334 fathoms. Station 208, Martinique, 213 fathoms. Station 211, Martinique, 357 fathoms. Station 273, Barbados, 103 fathoms. Station 276, Barbados, 94 fathoms. Station 288, Barbados, 399 fathoms. Station 291, Barbados, 200 fathoms. Bartlett, Station 24, 5 m. E. of Cape Cruz, S. side of Cuba, 206 fathoms.

Ophiothyreus Goesii Ljn.

Station 101, Morro Light, 175–250 fathoms. Station 155, Montserrat, 88 fathoms. Bartlett, Station 29, 21° 23′ 19″ N., 82° 54′ 42″ W., 300 fathoms.

Ophiernus adspersus sp. nov.

Plate III. Figs. 19-21.

Special Marks. — Two or three small, unequal arm-spines. Arms flat and very wide, their width being about one third the diameter of the disk. Mouth-frames narrow and prolonged.

Description of an Individual (Station 150). — Diameter of disk 13 mm. Width of arm close to disk 4 mm. Four short, rounded, bead-like, close-set papillæ on either side of the narrow, prolonged mouth-angle, and three longer ones under the teeth, which are five in number and are short and stout. There are also three or four bead-like papillæ on the side mouth-shield, and a much wider one outside them, all of which may be considered as scales of the second pair of mouth-tentacles. Mouth-shields about as broad as long, — 1.6 : 1.6, — of an angular heart-shape, with the point inward. Side mouth-shields long triangular, embracing the sides of the mouth-shields and not quite meeting within. First under arm-plate small and swollen, of an irregular rounded shape. The plates beyond are narrow, with lateral sides re-enteringly curved opposite the tentacle-pores. They are very small, and occupy not more than a quarter of the width of the arm. Side arm-plates wide, thin, and flat ; they do not quite meet below, and are broadly separated above by the upper arm-plates, which cover all that surface of the arm ; they are thus feebly arched, much wider than long, wider without than within, and having the outer and inner margins straight. Disk flat, with re-entering curves over the arms ; covered by thin, flat, irregular, strongly overlapping, ill-defined scales, which are beset with minute granules, of which there are about eight in the length of 1 mm. where they are closest. Radial shields nearly naked, of an irregular pear-seed shape, with the point inward, widely separated by the disk-scaling, and nearly naked ; length to breadth, 4 : 2. Lower interbrachial spaces more finely and regularly scaled. Genital openings long and wide, with a broad genital scale at the outer end. Arm-spines two, rarely three ; they are slender and peg-like. The upper one is longest, and about half as long as a joint. Two, rarely three, small, flat, oval tentacle-scales standing on the side arm-plate. Color in alcohol, pale gray. The fragile arms are long and slender, being about nine times the diameter of the disk. In its natural state the disk is probably closely granulated, but the grains are easily rubbed off.

The wide arms and different mouth-angles distinguish it from *O. vallincola.*

Station 129, Frederickstadt, 314 fathoms. Station 130, Santa Cruz, 451 fathoms. Station 150, between St. Kitts and Nevis, 375 fathoms. Station 148, St. Kitts, 208 fathoms. Station 161, Guadeloupe, 583 fathoms. Station 176, Dominica, 391 fathoms. Station 185, Dominica, 333 fathoms. Station 188, Dominica, 372 fathoms. Station 190, Dominica, 542 fathoms. Station 196, Martinique, 1,030 fathoms. Station 221, St. Lucia, 423 fathoms. Station 222, St. Lucia, 422 fathoms. Station 226, St. Vincent, 424 fathoms. Sta-

tion 230, St. Vincent, 464 fathoms. Station 239, Grenadines, 338 fathoms. Station 258, Grenada, 159 fathoms. Station 260, Grenada, 291 fathoms. Station 264, Grenada, 416 fathoms. Station 288, Barbados, 399 fathoms. Station 291, Barbados, 200 fathoms. Capt. Bartlett, 1880, Lat. 17° 30′ N., Long. 79° 14′ W., 555 fathoms ; also, 17° 45′ N., 77° 58′ W., 322 fathoms.

Ophioglypha fasciculata sp. nov.

Plate III. Figs. 22-24.

Special Marks. — Four spaced arm-spines. Upper surface of thick disk chiefly covered by radial shields, rosette of primary plates and large plate in each interbrachial space ; no large plate on margin. Basal under arm-plates broader than long. Whole surface microscopically tuberculous. Papillæ of arm-comb flattened spiniform.

Description of an Individual. — Diameter of disk 13 mm. Width of arm near disk 3 mm. Three or four rectangular, crowded papillæ on each side of a mouth-angle, and two or three conical ones at its apex. Mouth-shields very large, much longer than broad, having the outline of a wide-mouthed jug, and with the small lobe-like end inward ; length to breadth, 3 : 2. Side mouth-shields narrow, and of nearly equal width, meeting fully within. First under arm-plate larger than any other, longer than wide, narrower within than without ; the rest, within disk, are wider than long, and four-sided ; those beyond become gradually hexagonal. Side arm-plates swollen, meeting neither above nor below. Basal upper arm-plates more than twice as broad as long, with well-marked angles at their lateral ends. Disk thick, covered above by a central rosette of large primary plates and a large plate in each interbrachial space ; on margin of disk are a lot of small scales, and a single line between the chief plates. Lower interbrachial spaces partly covered by large mouth-shield, and partly by imbricated scales. Radial shields longer than wide, irregular and somewhat angular in outline, joined for about half their length. Genital scales narrow next radial shield, but growing wider without ; they bear on their free edge a continuous but not crowded line of small, sharp papillæ, which on the upper side of arm become spiniform, and form the comb. Four spaced arm-spines about two thirds as long as a joint. Tentacle-pores large ; mouth-tentacles with a straight line of five or six small, squarish, crowded scales on either side ; the others, within the disk, have usually five on the side arm-plate, and two or three on the under arm-plate. Color in alcohol, pale gray.

Station 281, Barbados, 288 fathoms, 2 specimens.

O. bullata is nearest, but differs in finer disk-scales, large marginal plates, separated radial shields, differently shaped arm-comb papillæ, and only three minute arm-spines.

Ophioglypha abyssorum sp. nov.

Plate III. Figs. 25-27.

Special Marks. — Surface microscopically tuberculous. Arm-spines rudimentary, or wanting. No papillæ along genital scale on the under surface, and only two or three in each arm-comb. Side arm-plates not swollen.

Description of an Individual. — Diameter of disk 11 mm. Width of arm near disk 2 mm. Four or five rectangular, crowded papillæ on either side of a mouth-angle, and one diamond-shaped (lowest tooth) at apex. Mouth-shields wide angular heart-shape, with a peak inward ; length to breadth, 2.5 : 2. Side mouth-shields rather wide, and meeting fully within. First under arm-plate larger than the rest, longer than wide, bell-shaped with a very gentle curve without, and a long curve within ; the next two plates are wider than long, rounded pentagonal with an angle inward ; those beyond are smaller, almost transverse diamond in form, with outer side gently curved. Side arm-plates meeting fully below ; also above, beyond the first two upper arm-plates, which are rounded diamond-shape with the inner angle truncated ; those beyond are as broad as long, and diamond-shaped with rounded angles. Disk smooth and not very thick, having in the centre a large, round primary plate, which is separated from the other five by a circle of smaller angular plates, similar to those which cover the rest of the disk, some of which are, however, larger. Radial shields large and a little sunken, of a short, irregular pear-seed shape, almost wholly separated by an outer and an inner wedge of disk-scales ; length to breadth, 3 : 2.3. Interbrachial spaces below chiefly filled by two large central plates and the broad genital scales, which bear no papillæ on their free edge. It is only on the upper surface of the arm, just outside the radial shields, that a rudimentary comb is found, made up of two or three block-like papillæ. The joints within the disk have one or two rudimentary spines, the rest none. Mouth-tentacle pores surrounded by eight or nine small, crowded block-like scales ; the next two have five such scales ; those beyond, one very minute papilla, or none. Color in alcohol, pale gray.

Station 140, Virgen Gorda, 1,097 fathoms, 5 specimens.

The species differs from *O. confragosa* in its even, microscopically tuberculated surface, its side arm-plates not swollen, under arm-plates of a different shape, and arm-spines rudimentary or wanting.

Ophioglypha scutata sp. nov.

Plate IV. Figs. 28-30.

Special Marks. — Upper disk chiefly covered by large radial shields and primary plates, with two plates in each interbrachial space. Papillæ of genital scale blunt, and forming above a close row. Three little arm-spines about one third as long as a joint.

Description of an Individual (Station 231). — Diameter of disk 6 mm. Width of arm close to disk 1 mm. Three short, oblong, close-set papillæ on each side of mouth-angle, and at its apex a group of three smaller and bluntly pointed ones, whereof the centre one is largest. Mouth-shield rounded quadrangular, with an angle inward ; length to breadth, 1 : 1. Side mouth-shields rather short and narrow, running along inner angle of mouth-shield. First under arm-plate large and triangular, with a curved outer side. The next three plates wider than long, with a gently curved outer side, an obtuse angle within, and re-entering curves on the sides. The plates beyond grow suddenly smaller, and are much wider than long. Side arm-plates large and a little swollen, meeting above and below. Upper arm-plates three-sided, with an angle inward. Disk flat, and covered above in the centre by a group of six large primary plates, whereof the middle one is pentagonal, and the rest rounded. Outside these are two large elongated plates, placed end to end and occupying the interbrachial space. The remaining upper surface is covered by very large radial shields, which are as wide as long, and of irregular outline, joined for their whole length, except at the inner point, where they are separated by a small scale ; length to breadth, 1.2 : 1.3. The lower interbrachial space is almost wholly occupied by a large hexagonal plate lying outside the mouth-shield and the rather wide genital scales, which bear blunt, bead-like papillæ continued in an unbroken line over top of arm just along outer edge of part of the radial shield. Three short, equal, stout, peg-like arm-spines, about one third as long as a joint. First three tentacle-pores, with three lumpy close-set scales on each side. The fourth has two scales on either side, and those beyond have none. Color in alcohol, white.

Station 231, off St. Vincent, 95 fathoms, 1 specimen.

This specimen is probably not adult, but its characters are so marked that there seems no doubt of its novelty. In the small number and large size of its disk-plates, it resembles *O. minuta*.

Ophioglypha tenera sp. nov.

Plate IV. Figs. 31-33.

Special Marks. — Three short, blunt, spaced arm-spines, less than half as long as a joint. Disk-scales somewhat swollen and mostly large. Radial shields joined for a part of their length. Papillæ of arm-comb close-set, flat, and with rounded ends.

Description of an Individual. — Diameter of disk 5.5 mm. Width of arm 1.2 mm. Mouth-angles large and regular, bearing on each side five or six low papillæ, which are much crowded, and form a straight line ; the outermost are much longer than high, while the inner ones are almost bead-like; at the apex and on the jaw-plate are two spiniform papillæ, between which appears the lowest tooth. Mouth-shields five-sided, bounded within by a well-marked angle, and without by a curve; length to breadth 1.2 : 1. Side mouth-shields

narrow and tapering within, where they join. First under arm-plate as broad as long, four-sided with much rounded corners. Those beyond have essentially a five-sided outline, but the second plate has its corners much rounded, while the others are more regular and have a well-marked peak within. Side arm-plates meeting below, but not above next the disk; slightly flaring so as to make a distinct shoulder, which carries the spines. Upper arm-plates broad wedge-shape, with an angle inward, which in the first two is truncated. Upper surface of disk with a central rosette of six slightly swollen, irregularly rounded primary plates, outside which is the great plate which separates the ends of the radial shields, and, in the interbrachial space, two other large plates, one of which is on the margin. Besides these there are numerous small intercalated scales. Interbrachial spaces below covered by half a dozen irregular angular plates ; besides which the narrow genital plates appear running along the genital openings quite to the margin of the disk. A row of fine papillæ stands on the edge of the genital scale, which grow suddenly larger, as the plate passes to the top of the arm, and form a close comb of flattened papillæ with rounded ends. Three small, equal, peg-like, spaced arm-spines, less than half as long as a joint. Mouth-tentacles with five or six minute, bead-like scales on each side ; the next have three or four ; the second and third have three on the side arm-plates, and the fourth, one. Color in alcohol, pale gray.

Station 269, off St. Vincent, 124 fathoms, 4 specimens.

This species stands nearest *O. costata*, but has longer arm-spines, disk-scales more swollen and separated, side arm-plates more flaring, and radial shields joined.

Ophioglypha aurantiaca Vll.

Vll., Amer. Journ. Sci., XXIII. p. 141, 1882.

Plate IV. Figs. 34-36.

Special Marks. — Disk covered by a smooth skin, through which the scales of the upper surface are scarcely to be made out, while those of the lower surface are more distinct. Three wide, flattened arm-spines, the upper one longer than an arm-joint, the others not so long. No comb above the base of the arm.

Description of an Individual (Station 312). — Diameter of disk 11.5 mm. Width of arm close to disk 2.5 mm. About eleven small, bead-like, slightly spaced mouth-papillæ to each angle. Four or five small spear-head-shaped teeth. Mouth-shield very wide heart-shaped, with an obtuse angle inward ; length to breadth, 2 : 1. Side mouth-shields long, with an irregular outline, and widest at their outer ends. First under arm-plate rounded hexagonal, and about as broad as long. The next two are of an irregular transverse oval shape, and those immediately beyond are much wider than long with a curve without and a peak within. Side arm-plates clinging close to the arm,

and but slightly swollen, scarcely meeting below near base of arm, and separated above by four-sided upper arm-plates, which are as broad as long, and have the outer side curved, and the laterals straight. Disk round, smooth, and somewhat swollen, covered by skin, through which the scaling of the upper surface is only vaguely indicated. In the lower interbrachial spaces the scales are plainly indicated ; they are thin, rounded, pretty even, and about three in the length of 2 mm. When the specimen is dry the scales are of course more distinct. Radial shields small, irregularly three-sided; widely separated, except at their outer ends, which overhang the arm. Along the edge of the genital opening, whose scale is completely obscured, runs a line of minute, sharp papillæ, which stops at the disk margin and does not pass upwards to form an arm-comb. Three wide, flattened, slightly rough arm-spines, whereof the uppermost is longer than a joint, the middle one as long as a joint, and the lowest one shortest and somewhat tapering. Each mouth-tentacle is surrounded by about ten small, bead-like, close-set scales ; the next pore has six, and those beyond two, which stand on the side arm-plate. Color in alcohol, pale gray ; of living animal, bright orange (Verrill).

Station 312, 39° 50′ 45″ N., 70° 11′ W., 466 fathoms. Station 306, 41° 32′ 50″ N., 65° 55′ W., 524 fathoms, 2 specimens.

A young one, with a disk of 4 mm., had more slender arm-spines, the back scaling less indistinct, and the under arm-plates narrower and more widely separated.

This species is nearest *O. flagellata*, but differs in having shorter arm-spines, and in wanting an arm-comb.

Ophioglypha affinis ?

Station 344, 40° 1′ N., 70° 58′ W.

Ophioglypha confragosa Lym.

Station 312, 39° 50′ 45″ N., 70° 11′ W. Young.

Ophioglypha Sarsii Lym.

Station 346, 40° 25′ 35″ N., 71° 10′ 30″ W., 44 fathoms. Station 332, 35° 45′ 30″ N., 74° 48′ W., 263 fathoms. Station 344, 40° 1′ N., 70° 58′ W., 129 fathoms. Station 303, 41° 34′ 30″ N., 65° 54′ 30″ W., 306 fathoms.

Ophioglypha lepida Lym.

Station 228, St. Vincent, 785 fathoms. Station 307, 41° 29′ 45″ N., 65° 47′ 10″ W., 980 fathoms. Bartlett, Station 14, Grand Cayman Island, 608 fathoms. Station 308, 41° 24′ 45″ N., 65° 35′ 30″ W., 1,242 fathoms. Bartlett, Station 18, 18° 20′ 30″ N., 87° 16′ 40″ W., 600 fathoms. Station 330,

31° 41′ N., 74° 35′ W., 1,047 fathoms. Station 339, 38° 16′ 45″ N., 73° 10′ 30″ W., 1,186 fathoms. Station 340, 39° 25′ 30″ N., 70° 58′ 40″ W., 1,394 fathoms. Station 341, 39° 38′ 20″ N., 70° 56′ W., 1,241 fathoms.

Ophioglypha Stuwitzii var.?

Station 321, 32° 43′ 25″ N., 77° 20′ 30″ W., 233 fathoms.

Ophioglypha acervata Lym.

Station 132, Santa Cruz, 115 fathoms. Station 143, Saba Bank, 150 fathoms. Station 149, St. Kitts, 60–150 fathoms. Station 177, Dominica, 118 fathoms. Station 253, Grenada, 92 fathoms. Station 259, Grenada, 159 fathoms. Station 262, Grenada, 92 fathoms. Station 316, 32° 7′ N., 78° 37′ 30″ W., 229 fathoms. Station 315, 32° 18′ 20″ N., 78° 43′ W., 225 fathoms.

NOTES ON OPHIOGLYPHA.

Ophioglypha falcifera Lym.

Plate IV. Figs. 37-39.

In the original description (Bull. Mus. Comp. Zoöl., I., No. 10, p. 320) I said: "We may look for an adult of this curious species about the size of *O. Sarsii*, or rather smaller, and having a large number of small plates on the disk."

A considerable number of specimens were brought in by this expedition, of which the largest had a disk of 13 mm., and the arm 52 mm. long. The disk was covered by coarse, well-defined scales, the interbrachial margin being almost wholly occupied by a single plate. The hook-like form of the middle arm-spine could be traced to within half a dozen joints of the disk.

Station 130, Frederickstadt, 451 fathoms. Station 136, Frederickstadt, 508 fathoms. Station 185, Dominica, 333 fathoms. Station 188, Dominica, 372 fathoms. Station 195, Martinique, 502½ fathoms. Station 204, Martinique, 476 fathoms. Station 221, St. Lucia, 423 fathoms. Station 222, St. Lucia, 422 fathoms. Station 226, St. Vincent, 424 fathoms. Station 230, St. Vincent, 464 fathoms. Station 265, Grenada, 576 fathoms. Station 291, Barbados, 200 fathoms.

Ophioglypha variabilis Lym.

Specimens from about thirty stations showed a good deal of variation. Some were like Fig 70, Pl. III., Bull. M. C. Z. V., No. 7, while others had two or three vertical rows of scales in the lower interbrachial spaces. The scales on the back of the disk also varied in size and number. Likewise the second or under arm-comb had sometimes numerous and sometimes very few papillæ.

Station 101, Morro Light, 175–250 fathoms. Station 130, Frederickstadt, 451 fathoms. Station 136, Frederickstadt, 508 fathoms. Station 137, Frederickstadt, 625 fathoms. Station 148, St. Kitts, 208 fathoms. Station 161, Guadeloupe, 583 fathoms. Station 162, Guadeloupe, 734 fathoms. Station 163, Guadeloupe, 769 fathoms. Station 173, Guadeloupe, 734 fathoms. Station 174, Guadeloupe, 878 fathoms. Station 175, Dominica, 608 fathoms. Station 179, Dominica, 824 fathoms. Station 185, Dominica, 333 fathoms. Station 188, Dominica, 372 fathoms. Station 200, Martinique, 472 fathoms. Station 208, Martinique, 213 fathoms. Station 221, St. Lucia, 423 fathoms. Station 226, St. Vincent, 424 fathoms. Station 227, St. Vincent, 573 fathoms. Station 228, St. Vincent, 785 fathoms. Station 230, St. Vincent, 464 fathoms. Station 239, Grenadines, 338 fathoms. Station 257, Grenada, 553 fathoms. Station 260, Grenada, 291 fathoms. Station 264, Grenada, 416 fathoms. Station 265, Grenada, 576 fathoms.

Ophioglypha irrorata? Lym.

The specimens seemed just the same as those from Station 164 of the "Challenger" (Bull. M. C. Z., V., No. 7, p. 74). They differed from those from the coast of Portugal, called *O. irrorata* (?) in the postscript to my Challenger Ophiuroidea (p. 381), in having three arm-spines set close together, whereas the latter had two below, and one separated and higher up; while farther out they were close together, and the middle one had the form of a blunt hook.

Station 140, Virgen Gorda, 1,097 fathoms. Station 245, Grenada, 1,058 fathoms.

Ophioglypha convexa? Lym.

Plate IV. Figs. 40-45.

Most of the specimens differ so much from *O. convexa* as to appear like another species. The six primary plates, extremely swollen, form an elevated rosette, overhanging very small radial shields, not so large as the head of the genital scale. The mouth-shield, too, occupies the *whole* of the lower interbrachial space (fig. 43). But specimens from Station 148 were intermediate, or rather differed from the typical form only in finer arm-comb papillæ and more interbrachial scales on the disk margin. It will be necessary to await further dredgings before deciding the specific limits. It is to be noted as an important difference, that, while the typical *O. convexa* is found in 2,350 fathoms, this species does not go below 240 fathoms.

Station 145, St Kitts, 270 fathoms. Station 157, Montserrat, 120 fathoms. Station 158, Montserrat, 148 fathoms. Station 220, St. Lucia, 116 fathoms. Station 224, St. Vincent, 114 fathoms.

Ophiocten Pattersoni sp. nov.

Plate IV. Figs. 46-48.

Special Marks. — Longest arm-spine as long as one and a half arm-joints. Disk covered above irregularly with larger and smaller scales. Arm-comb feeble. One wide mouth-papilla on each side, and two spiniform farther in, with one at apex of mouth-angle.

Description of an Individual. — Diameter of disk 9.5 mm. Width of arm close to disk 1.6 mm. A very wide papilla at outer corner of mouth-angle, and two spiniform within it, on either side, and one or two at the apex. Three slender, spike-like teeth. Mouth-shields rounded squarish, as broad as long, with an ill-marked angle within ; length to breadth, 1.2 : 1.2. Side mouth-shields very narrow, of equal width, meeting fully within. First under arm-plate large, about as broad as long, of a rudely rhomboidal form, with a rounded angle outward ; the rest are much wider than long, with a rounded angle without, a little peak within, and sharp lateral corners. Side arm-plates slightly flaring outward, meeting broadly below, where they cover most of the arm; separated above by the upper arm-plates, which are much broader than long, and a little wider without than within ; length to breadth, .8 : 1.5. Disk circular and flat on top, where it is covered with fine, thin scales, among which appear numerous irregular plates, which form a continuous patch at the margin. Radial shields small, irregular, and widely separated. Interbrachial spaces below covered by a more regular imbricated scaling, and without plates. Genital scales hidden, except their outer ends, just outside the radial shields, which bear a feeble arm-comb of half a dozen or less minute papillæ. Tentacle-pores large ; the outer ones are furnished with a small scale, which often is lacking on the basal pores. Three very slender, tapering arm-spines, the uppermost and longest one as long as one and a half or two joints. Color in alcohol, pale yellowish gray.

Station 344, Lat. 40° 1′ N., Long. 70° 58′ W., 129 fathoms, 1 specimen.

Ophiomusium eburneum Lym.

Bull. M. C. Z., I. 10, p. 322, 1869. Ill. Cat. M. C. Z., VI., Pl. II. figs. 1, 2, 3.

It happened strangely enough that the specimen originally described by me was only half grown and aberrant, differing from ordinary specimens somewhat in the comparative thinness of the disk scales, but chiefly in the narrowness of the arm, which was only 1.3 mm., while an average individual with a similar disk (9 mm.) would have an arm 2 mm. wide. I found, however, one or two whose arms were not much wider than those of the type.

This species attains a good size. One with a disk of 15 mm. had arms about 50 mm. long and 3 mm. wide. The radial shields were more elongated than in the type, and there were three little arm-spines.

In looking over a large series, there may be found some difference in the form of the radial shields, in the size and thickness of the fine central scales of the disk, in the length and number of the arm-spines, which may be two or three, and in the width of the arm.

Constant features are the somewhat swollen and microscopically tuberculous side arm-plates, the numerous and comparatively thin disk scales, and the presence of only *two* under arm-plates furnished with tentacles.

Station 100, off Morro Light, 250–400 fathoms. Station 132, Santa Cruz, 115 fathoms. Station 147, St. Kitts, 250 fathoms. Station 159, Guadeloupe, 196 fathoms. Station 176, Dominica, 390 fathoms. Station 177, Dominica, 118 fathoms. Station 185, Dominica, 333 fathoms. Station 208, Martinique, 213 fathoms. Station 215, St. Lucia, 226 fathoms. Station 218, St. Lucia, 164 fathoms. Station 231, St. Vincent, 95 fathoms. Station 238, Grenadines, 127 fathoms. Station 240, Grenadines, 164 fathoms. Station 241, Grenadines, 163 fathoms. Station 248, Grenada, 161 fathoms. Station 249, Grenada, 262 fathoms. Station 258, Grenada, 159 fathoms. Station 262, Grenada, 92 fathoms. Station 263, Grenada, 159 fathoms. Station 269, St. Vincent, 124 fathoms. Station 274, Barbados, 209 fathoms. Station 280, Barbados, 221 fathoms.

Ophiomusium Lymani Wyv. Thom.

Plate V. Figs. 55-57. (Young.)

The young, with a disk not larger than 5 mm., would be taken for a new species. On the back is an elevated rosette of thick primary plates, each having a central boss. Outside these lie the thick radial shields, and, in the interbrachial spaces, two plates, the marginal one much the larger. Below, it has, besides the genital scales, one large plate outside the mouth-shield, and two or three very small ones on the margin. With a disk of 8 mm. it resembles the adult of *O. validum*, of the same size, except that the latter has larger radial shields, fewer central scales, and, below, scarcely more than one great plate outside the mouth-shield.

Station 331, 35° 44′ 40″ N., 74° 40′ 20″ W., 898 fathoms.

The following were adult : —

Station 305, 41° 33′ 15″ N., 65° 51′ 25″ W., 810 fathoms. Station 307, 41° 29′ 45″ N., 65° 47′ 10″ W., 980 fathoms. Station 308, 41° 24′ 45″ N., 65° 35′ 30″ W., 1242 fathoms. Station 330, 31° 41′ N., 74° 35′ W., 1047 fathoms. Station 331, 35° 44′ 40″ N., 74° 40′ 20″ W., 898 fathoms. Station 338, 38° 18′ 40″ N., 73° 18′ 10″ W., 922 fathoms. Station 339, 38° 16′ 45″ N., 73° 10′ 30″ W., 1186 fathoms. Station 341, 39° 38′ 20″ N., 70° 56′ W., 1241 fathoms. Station 342, 39° 43′ N., 70° 55′ 25″ W., 1002 fathoms.

Ophiomusium validum Ljn.

Station 100, off Morro Light, 250–400 fathoms. Station 101, off Morro Light, 175–200 fathoms. Station 117, Porto Rico, 874 fathoms. Station 131, Santa Cruz, 580 fathoms. Station 134, Santa Cruz, 248 fathoms. Station 145, St. Kitts, 270 fathoms. Station 146, St. Kitts, 245 fathoms. Station 148, St. Kitts, 208 fathoms. Station 149, St. Kitts, 60–180 fathoms. Station 161, Guadeloupe, 583 fathoms. Station 162, Guadeloupe, 734 fathoms. Station 163, Guadeloupe, 769 fathoms. Station 173, Guadeloupe, 734 fathoms. Station 174, Guadeloupe, 878 fathoms. Station 175, Dominique, 608 fathoms. Station 190, Dominique, 542 fathoms. Station 195, Martinique, 501 fathoms. Station 200, Martinique, 472 fathoms. Station 211, Martinique, 357 fathoms. Station 212, Martinique, 317 fathoms. Station 222, St. Lucia, 422 fathoms. Station 227, St. Vincent, 573 fathoms. Station 228, St. Vincent, 785 fathoms. Station 238, Grenadines, 127 fathoms. Station 257, Grenada, 553 fathoms. Station 259, Grenada, 159 fathoms. Station 261, Grenada, 340 fathoms. Station 264, Grenada, 416 fathoms. Station 291, Barbados, 200 fathoms. Bartlett, Station 4, 20° 24′ 15″ N., 73° 56′ 50″ W., 772 fathoms. Bartlett, Station 8, 17° 45′ N., 77° 58′ 40″ W., 322 fathoms. Bartlett, Station 18, 18° 20′ 30″ N., 87° 16′ 40″ W., 600 fathoms.

Ophiomusium testudo Lym.

Station 100, off Morro Light, 250–400 fathoms. Station 132, Frederickstadt, 115 fathoms. Station 136, Frederickstadt, 508 fathoms. Station 155, Montserrat, 88 fathoms. Station 157, Montserrat, 120 fathoms. Station 158, Montserrat, 148 fathoms. Station 177, Dominique, 118 fathoms. Station 178, Dominique, 130 fathoms. Station 224, St. Vincent, 114 fathoms. Station 232, St.Vincent, 88 fathoms. Station 262, Grenada, 92 fathoms. Station 272, Barbados, 76 fathoms. Station 273, Barbados, 103 fathoms. Station 276, Barbados, 94 fathoms. Station 278, Barbados, 69 fathoms. Station 290, Barbados, 73 fathoms. Bartlett, Station 29, 21° 23′ 19″ N., 82° 54′ 42″ W., 300 fathoms.

Ophiomusium planum Lym.

Bartlett, Station 29, 21° 23′ 19″ N., 82° 54′ 42″ W., 300 fathoms.

Ophiomusium acuferum Lym.

Station 132, Santa Cruz, 115 fathoms. Station 143, Saba Bank, 150 fathoms. Station 149, St. Kitts, 60–180 fathoms. Station 142, Flannegan Passage, 27 fathoms. Station 155, Montserrat, 88 fathoms. Station 156, Montserrat, 88 fathoms. Station 167, Guadeloupe, 175 fathoms. Station 177, Dominica, 118 fathoms. Station 196, Martinique, 1030 fathoms. Station 206, Marti-

nique, 170 fathoms. Station 210, Martinique, 191 fathoms. Station 220, St. Lucia, 116 fathoms. Station 224, St. Vincent, 114 fathoms. Station 231, St. Vincent, 95 fathoms. Station 233, St. Vincent, 174 fathoms. Station 253, Grenada, 92 fathoms. Station 254, Grenada, 164 fathoms. Station 262, Grenada, 92 fathoms. Station 269, St. Vincent, 124 fathoms. Station 272, Barbados, 76 fathoms. Station 273, Barbados, 103 fathoms. Station 274, Barbados, 209 fathoms. Station 276, Barbados, 94 fathoms. Station 277, Barbados, 106 fathoms. Station 278, Barbados, 69 fathoms. Station 281, Barbados, 288 fathoms. Station 290, Barbados, 73 fathoms. Station 291, Barbados, 200 fathoms. Station 292, Barbados, 56 fathoms. Station 293, Barbados, 82 fathoms. Station 296, Barbados, 84 fathoms. Station 297, Barbados, 123 fathoms. Station 299, Barbados, 140 fathoms. Station 300, Barbados, 82 fathoms. Bartlett, Station 29, 21° 23′ 19″ N., 82° 54′ 42″ W., 300 fathoms. Entrance to Port Royal, Jamaica, 100 fathoms.

Ophiomusium serratum Lym.

Station 136, Frederickstadt, 508 fathoms. Station 140, Virgen Gorda, 1097 fathoms. Station 205, Martinique, 334 fathoms. Station 211, Martinique, 357 fathoms. Station 214, Martinique, 476 fathoms. Station 230, St. Vincent, 464 fathoms. Station 260, Grenada, 291 fathoms. Station 269, St. Vincent, 124 fathoms. Station 274, Barbados, 209 fathoms. Station 280, Barbados, 221 fathoms. Station 288, Barbados, 399 fathoms. Bartlett, Station 8, 17° 45′ N., 77° 58′ 40″ W., 322 fathoms. Bartlett, Station 24, 5 m. E. of Cape Cruz, S. side of Cuba, 206 fathoms.

Ophiomastus texturatus sp. nov.

Plate IV. Figs. 49-51.

Special Marks. — Three minute arm-spines. Disk covered above by a central rosette of eleven plates, from which radiate ten single lines of plates. Radial shields large and oblong.

Description of an Individual. — Diameter of disk 4.7 mm. Width of arm, near disk, 1.7 mm. A row of four or five small, block-like papillæ on each side of a mouth-angle ; they are so closely wedged together as to form an apparently continuous line. Teeth resembling mouth-papillæ in form and size. Mouth-shields small, as broad as long, bounded by a curve without and an angle within ; length to breadth, .7 : .7. Side mouth-shields pointed, oval, large, widely joined within. Under arm-plates small, occupying less than one third the width of the arm, five-sided, with outer edge curved, laterals re-enteringly curved, and an angle within. Side arm-plates very large, meeting above and below, and covering the greater part of the broad arm. Upper arm-plates small, occupying little more than a third of the width of arm, trans-

verse oval. The surface of the arm, as well as that of the disk, is microscopically tuberculous. Disk covered above by swollen plates, of which there is a central rosette of eleven ; one ten-sided in the midst, and surrounding it ten hexagonal, with unequal sides, whereof the brachial plates are the largest ; all are continued, by single rows of small plates, to margin of disk. Below, the interbrachial space is occupied by large, thick genital plates, and by two others placed on the median line. Radial shields large, longer than broad, wider without than within, where they join the central rosette ; length to breadth, 1.2 : .9. Genital openings narrow and very short, beginning at outer corner of radial shield. Three very small peg-like arm-spines, less than half as long as a joint. Second pair of mouth-tentacles issuing from pores just inside the side mouth-shields ; first pair of arm-tentacles with three minute, lip-like scales ; those beyond usually with only one small scale. Color in alcohol, pale gray.

"Challenger" Expedition, Station 173, 310 fathoms, 1 specimen.

Ophiomastus secundus Lym.

Station 136, Santa Cruz, 508 fathoms. Station 149, St. Kitts, 60–150 fathoms. Station 163, Guadeloupe, 769 fathoms. Station 179, Dominica, 824 fathoms. Station 180, Dominica, 982 fathoms. Station 182, Dominica, 1131 fathoms. Station 185, Dominica, 333 fathoms. Station 196, Martinique, 1030 fathoms. Station 205, Martinique, 334 fathoms. Station 211, Martinique, 357 fathoms. Station 230, St. Vincent, 464 fathoms. Station 288, Barbados, 399 fathoms. Station 325, 33° 35′ 20″ N., 76° W., 647 fathoms. Station 326, 33° 42′ 15″ N., 76° 0′ 50″ W., 464 fathoms. Station 329, 34° 39′ 40″ N., 75° 14′ 40″ W., 603 fathoms.

Ophiophyllum petilum? Lym.

Bull. M. C. Z., V. 7, p. 130, Pl. VII. Figs. 179–181.

Plate IV. Figs. 52-54.

The single specimen brought up from 542 fathoms at Station 190, near Dominica, differed from the type in having, near the base of the arm, a small, peg-like, additional arm-spine, standing just above the peculiar flat, curved, translucent spine, which seems like a continuation of the free plates which border the disk. Also there were not so many plates in the lower brachial space. All the disk plates were thin and more or less diaphanous, so that their outlines were hard to make out unless the specimen was partly dried. These differences may be constant and specific ; but I prefer to leave them in doubt because only one adult specimen of the typical *O. petilum* was brought back by the "Challenger."

There is a certain resemblance in some parts of the Ophiuran fauna of the Fijis from depths of 200 to 600 fathoms to that of the West Indies at the

same depths. From the former we now have *Astroschema salix* and *horridum*, (?) *Ophioceramis clausa*, *Ophiactis cuspidata*, *O. flexuosa*, *O. nama*, *Amphiura canescens*, *A. argentea*, *A. bellis*, *Ophiomitra plicata*, *Ophiacantha cornuta*, *O. vepratica*, *Ophiophyllum petilum*, *Ophiochiton lentus*, *Ophiomusium scalare*, *Ophioconis pulverulenta*, *Ophiopyrgus Wyville-Thomsoni*, *Ophiopyren brevispinus*, *Ophiozona insularia*, and *Ophiomyxa australis*. Of these *Ophiophyllum petilum*, *Ophiacantha vepratica*, and *Ophioconis pulverulenta* correspond very closely with the Ophiophyllum above mentioned, with *Ophiacantha Bairdi*, and with *Ophioconis miliaria*. In both faunæ is found exclusively the peculiar genus Ophiopyren, and Ophiozona exists in both. *Ophiomusium scalare* and *Ophiomitra plicata* stand pretty near *Ophiomusium testudo* and *Ophiomitra chelys*. The genus Astroschema, so richly represented in the West Indies, has two species in this list of twenty. As a contrast comes the extraordinary form Ophiopyrgus, known thus far only from the neighborhood of the Fijis. It remains for future dredgings to show whether these resemblances result probably from community of origin, or simply indicate the presence of a nearly identical fauna over vast tracts of deep-sea bottom.

Ophiopyren longispinus Lym.

Station 130, Santa Cruz, 451 fathoms. Station 136, Santa Cruz, 508 fathoms. Station 137, Santa Cruz, 625 fathoms. Station 149, St. Kitts, 60–150 fathoms. Station 156, Montserrat, 88 fathoms. Station 185, Dominica, 333 fathoms. Station 188, Dominica, 372 fathoms. Station 190, Dominica, 542 fathoms. Station 204, Martinique, 476 fathoms. Station 205, Martinique, 334 fathoms. Station 211, Martinique, 357 fathoms. Station 212, Martinique, 317 fathoms. Station 221, St. Lucia, 423 fathoms. Station 222, St. Lucia, 422 fathoms. Station 230, St. Vincent, 464 fathoms. Station 246, Grenada, 154 fathoms. Station 260, Grenada, 291 fathoms. Bartlett, Station 18, 18° 20′ 30″ N., 87° 16′ 40″ W., 600 fathoms.

Ophioconis miliaria Lym.

Station 187, Dominica, 411 fathoms. Station 222, St. Lucia, 422 fathoms. Station 241, Grenadines, 163 fathoms. Station 260, Grenada, 291 fathoms.

Ophiochœta mixta Lym.

Station 170, Guadeloupe, 309 fathoms. Station 249, Grenada, 262 fathoms. Station 265, Grenada, 576 fathoms.

Ophiopholis aculeata Gray.

Station 309, 40° 11′ 40″ N., 68° 22′ W., 304 fathoms. Station 310, 39° 59′ 16″ N., 70° 18′ 30″ W., 260 fathoms. Station 335, 38° 22′ 25″ N., 73° 33′ 40″ W., 89 fathoms.

Ophiactis Mülleri (var. quinqueradia) Lтк.

Station 142, Flannegan Passage, 27 fathoms. Station 152, St. Kitts, 122 fathoms. Station 210, Martinique, 121 fathoms. Station 239, Grenadines, 338 fathoms. Station 272, Barbados, 76 fathoms. Station 278, Barbados, 69 fathoms.

Amphiura incisa sp. nov.

Plate V. Figs. 58-60.

Special Marks. — Two scale-like papillæ on each side of mouth-angle, and a pair at its apex. Two large tentacle-scales. Upper disk-scales thick and irregular and separated by depressions.

Description of an Individual. — Diameter of disk 7.5 mm. Width of arm close to disk 1.7 mm. Two wide, scale-like papillæ at base of mouth-angle on either side, and a pair of thicker ones at its apex. Four stout squarish teeth; the lowest one smallest and more rounded than those above. Mouth-shields small, rounded, and with a peak inward; length to breadth, .7 : .7. Side mouth-shields long and large; broader without than within, where they meet. First under arm-plate small and rounded; often partly covered by the outer mouth-papillæ. The plates beyond are of a regular narrow shield-shape, having a straight outer side where they are widest; re-enteringly curved laterals, and an angle within. Side arm-plates flat, with a low spine-ridge, barely meeting above, and scarcely separated below. Upper arm-plates separated; narrow transverse oval, more than twice as broad as long. Disk rather thick, with an undulating border; covered above by thick, irregular, somewhat angular scales, which are separated by sunken lines, and have the look of a loose mosaic. Below, the scales are smaller and much more rounded and regular, but are strongly separated. Radial shields small, pear-seed shape, and separated by a narrow wedge of three scales; length to breadth, 1.5 : 1. Three stout, blunt, rounded arm-spines, about as long as a joint; the middle one is stoutest and has a microscopically rough surface. Two wide, large tentacle-scales, standing one on the side and one on the under arm-plate. Color in alcohol, pale brown.

Station 161, near Guadeloupe, 583 fathoms, 2 specimens.

This species is nearest *A. Riisei*, from which it is strongly distinguished by separated upper arm-plates and radial shields, and much coarser arm-spines and disk-scales.

Amphiura nereis sp. nov.

Plate V. Figs. 61-63.

Special Marks. — Five papillæ on each side of a mouth-angle. Three arm-spines. Radial shields small, narrow and separated. A row of minute papillæ along genital scale.

Description of an Individual. — Diameter of disk 4.5 mm. Width of arm without spines 1 mm. Four small scale-like mouth-papillæ on each side of an angle, and a pair at the apex. The papilla next the outermost one is commonly the largest. Mouth-shields about as broad as long, rounded, with a slight peak within ; length to breadth, .6 : .6. Side mouth-shields small, and extremely narrow within, where they barely meet. Their outer ends are club-shaped. First under arm-plate minute and three-cornered ; those beyond are of a squarish shield-shape, with outer side straight, laterals a little re-enteringly curved, and an obtuse or truncated angle within. Side arm-plates moderately stout, and nearly meeting above and below. Upper arm-plates transverse oval, and about twice as broad as long. Disk rather thick, and covered above and below with small, crowded, overlapping, somewhat irregular scales, of which there are seven or eight in the length of 1 mm. In centre of upper surface are the small, round, widely separated primary plates. Along edge of genital scale is a row of fine papillæ. Radial shields small, narrow, and separated by bunches of scales ; their length is about .8 mm. Three rather stout, rounded, tapering arm-spines, about as long as a joint ; the middle one being somewhat the longest. One oval tentacle-scale on the side arm-plate, and a smaller and narrower one on the under plate. Color in alcohol, pale gray.

Station 158, Montserrat, 148 fathoms, 1 specimen.

This species is perhaps nearest to *A. tumida*, from which it differs in having much larger mouth-papillæ, and a row of papillæ along the genital scale.

Amphiura duplicata Lym.

Station 132, Santa Cruz, 115 fathoms. Station 134, Santa Cruz, 248 fathoms. Station 136, Santa Cruz, 508 fathoms. Station 145, St. Kitts, 270 fathoms. Station 147, St. Kitts, 250 fathoms. Station 148, St. Kitts, 208 fathoms. Station 151, Nevis, 356 fathoms. Station 154, Montserrat, 298 fathoms. Station 155, Montserrat, 88 fathoms. Station 161, Guadeloupe, 583 fathoms. Station 167, Guadeloupe, 175 fathoms. Station 173, Guadeloupe, 734 fathoms. Station 176, Dominica, 390 fathoms. Station 185, Dominica, 333 fathoms. Station 204, Martinique, 476 fathoms. Station 206, Martinique, 170 fathoms. Station 210, Martinique, 191 fathoms. Station 216, St. Lucia, 154 fathoms. Station 218, St. Lucia, 164 fathoms. Station 220, St. Lucia, 116 fathoms. Station 221, St. Lucia, 423 fathoms. Station 227, St. Vincent, 573 fathoms. Station 238, Grenadines, 127 fathoms. Station 239, Grenadines, 338 fathoms. Station 241, Grenadines, 163 fathoms. Station 260, Grenada, 291 fathoms. Station 261, Grenada, 340 fathoms. Station 264, Grenada, 416 fathoms. Station 272, Barbados, 76 fathoms. Station 273, Barbados, 103 fathoms. Station 274, Barbados, 209 fathoms. Station 275, Barbados, 218 fathoms. Station 276, Barbados, 94 fathoms. Station 290, Barbados, 73 fathoms.

Amphiura Otteri Ljn.

Station 115, 17° 55′ N., 76° 41′ 20″ W., 228 fathoms. Station 167, Guadeloupe, 175 fathoms. Station 265, Grenada, 576 fathoms. Station 306, 41° 32′ 50″ N., 65° 55′ W., 524 fathoms. Station 310, 39° 59′ 16″ N., 70° 18′ 30″ W., 260 fathoms. Station 336, 38° 21′ 50″ N., 73° 32′ W., 197 fathoms.

Amphiura tumida Lym.

Station 184, Dominica, 94 fathoms.

Amphiura tenuispina Ljn.

Station 215, St. Lucia, 226 fathoms. Station 223, St. Vincent, 146 fathoms. Station 246, Grenada, 154 fathoms.

Amphiura lunaris Lym.

Station 226, St. Vincent, 424 fathoms.

Amphiura grandisquama Lym.

Station 316, 32° 7′ N., 78° 37′ 30″ W., 229 fathoms. Station 319, 32° 25′ N., 77° 42′ 30″ W., 262 fathoms.

Amphiura flexuosa? Ljn.

Station 319, 32° 25′ N., 77° 42′ 30″ W., 262 fathoms.

Amphiura cuneata Lym.

Station 256, Grenada, 370 fathoms. Station 259, Grenada, 159 fathoms.

Amphiura Stimpsoni Ltk.

Station 278, Barbados, 69 fathoms.

NOTES ON AMPHIURA.

Amphiura sp. nov.?

Near *A. semiermis*, but has disk-scales much larger and fewer, and two *large* tentacle-scales. There are five short, tapering equal arm-spines. The lower interbrachial space is naked, except a few scales near the mouth-shields.

Station 244, near Grenada, 792 fathoms, 1 specimen.

Amphiura sp. nov.?

Near *A. divaricata*, from which it differs in having radial shields scarcely separated, in coarser lower disk-scales, in having a larger tentacle-scale on the

under arm-plate, and in having five (not six) arm-spines, of which the lower are larger, and have a rudimentary cross-piece at the tip.

Station 211, Martinique, 357 fathoms, 1 specimen.

Amphiura sp. nov.?

Plate V. Figs. 64-66.

Similar to preceding (Station 211), but with much smaller tentacle-scales; sharp mouth-papillæ.

Station 220, St Lucia, 116 fathoms, 1 specimen.

These last three species may be new ; but as the Amphiuræ are so numerous and run so close, I prefer to await a larger series of specimens.

Amphiura Verrilli? (young,) Lym.

Differs from the type in having smaller radial shields and the primary disk-plates not conspicuous.

Station 226, St. Vincent, 424 fathoms, 1 specimen.

Amphiura tomentosa? (young,) Lym.

Differs from the original in having the radial shields touching and side arm-plates meeting above. These may be characters of the young.

Station 230, St. Vincent, 464 fathoms, 1 specimen.

Amphiura angularis Lym.

It seems to differ from the type only in having radial shields a little closer and the disk-scaling less marked. Both *A. angularis* and *A. tomentosa* are from the Kerguelen Islands.

Station 204, Martinique, 476 fathoms, 1 specimen. Station 288, Barbados, 399 fathoms, 1 specimen.

Ophiocnida olivacea Lym.

Station 344, 40° 1′ N., 70° 58′ W., 129 fathoms.

Ophionema intricata Ltk.

(Young.) Station 128, Santa Cruz, 180 fathoms.

Ophionereis reticulata Ltk.

Station 142, Flannegan Passage, 27 fathoms. Station 155, Montserrat, 88 fathoms. Station 276, Barbados, 94 fathoms. Station 278, Barbados, 69 fathoms. Bartlett, Pedro Bank, 4 fathoms.

Ophiopsila fulva Lym.

Station 155, Montserrat, 88 fathoms. Station 278, Barbados, 69 fathoms.

Ophiopsila Riisei Ltk.

Station 285, Barbados, 13–40 fathoms. Station 287, Barbados, 7½–50 fathoms.

Ophioplax Ljungmani Lym.

Station 101, Morro Light, 175–250 fathoms. Station 132, Santa Cruz, 115 fathoms. Station 155, Montserrat, 88 fathoms Station 156, Montserrat, 88 fathoms. Station 177, Dominique, 118 fathoms. Station 220, St. Lucia, 116 fathoms. Station 232, St. Vincent, 88 fathoms. Station 273, Barbados, 103 fathoms. Station 277, Barbados, 106 fathoms. Station 297, Barbados, 123 fathoms. Bartlett, Station 10, 18° 13′ 20″ N., 78° 36′ 40″ W., 103 fathoms.

Ophiostigma isacanthum Lym.

Station 132, Santa Cruz, 115 fathoms. Station 152, St. Kitts, 122 fathoms.

Ophiochytra tenuis sp. nov.

Plate III. Figs. 16-18.

Special Marks. — Two very large scale-like papillæ at outer end of mouth-angle, and two small ones, within and higher in the slit. A few grains in neighborhood of mouth-shield.

Description of an Individual. — Diameter of disk 5 mm. Width of arm near disk 1 mm. At outer end of mouth-angle on either side are two large, flat, rounded scale-like papillæ, while within and higher on the mouth-frame may be seen two which are minute. At base of mouth-frames, in the centre, is a group of half a dozen grains, covering inner ends of the side mouth-shields, which are long, narrow and bent; wider without than within where they fully join and extend as a sharp angle under the mouth-frames to a level with the second great mouth-papilla. Mouth-shields small, about as long as broad, with a well-marked angle inward ; length to breadth, .5 : .6. First under arm-plate smaller than those beyond, and making a furrow at outer corner of mouth-slit. The plates just beyond are axe-shaped with a curve without, an angle within, and deep re-entering curves where the tentacles protrude. Side arm-plates meeting above and nearly so below ; beyond the disk they are a little swollen so as to give a slightly wavy outline to the arm. Upper arm-plates fan-shaped, with an angle inward. Disk evenly covered with thin

imbricated scales, whereof the lower ones are nearly as large as the mouth-shields, near which are a few grains. Radial shields small and not touching; nearly twice as wide as long, and separated from upper surface of arm by a cluster of scales. Genital openings extending from mouth-shield to margin of disk. Two stout, cylindrical, blunt arm-spines, about two thirds as long as a joint. One large circular tentacle-scale. Color in alcohol, pale gray.

Station 239, Grenadines, 383 fathoms, 6 specimens. Station 260, Grenada, 291 fathoms, 5 specimens.

The only other species of this genus, *O. epigrus*, comes from Low Archipelago, southeast of the Sandwich Islands, at a depth of over 2500 fathoms.

Ophiocoma pumilla Lтк.

Bartlett, Pedro Bank, 4 fathoms.

Ophiochiton ternispinus sp. nov.

Plate V. Figs. 67-69.

Special Marks. — One tentacle-scale. Three slender, rather long arm-spines.

Description of an Individual. — Diameter of disk 12 mm. Length of arm 60 mm. Width of arm near disk 2 mm. Twelve mouth-papillæ to each angle, whereof the four inner ones, on either side, are short, pointed and spaced, while the two outer ones are flattened and crowded. Teeth stout, flat, and shaped like a blunt spear-head. Mouth-shields regular pointed heart-shaped, with a small rounded lobe without. Length to breadth, 2 : 1.3. Side mouth-shields very narrow within, where they barely meet; but spreading widely without, where they bound a part of the inner end of the genital opening. First under arm-plate rounded and small, not larger than the neighboring mouth-papilla. The plates beyond are much narrower than the arm; they are about as broad as long, much wider without than within, with an outer curve, re-entering curves on the sides, and a truncated angle within. They are somewhat swollen, but have no ridge. Side arm-plates even, slightly flaring, nearly meeting above and below. Upper arm-plates narrower than the arm, much longer than wide, bounded on all sides by gentle curves. Disk covered with thin, irregular, overlapping scales, and having in the centre a group of much larger rounded primary plates, 1 mm. in diameter. Below, the scaling is similar but finer. Radial shields narrow oblong, or egg-shape, small, separated by a narrow wedge of fine scales; length to breadth, 2 : 1. Genital openings large and long, extending from mouth-shield to margin of disk. Three smooth, slender, tapering arm-spines, whereof the uppermost may be as long as two joints. Lengths, to that of an under arm-plate, 2.5, 1.2, 1.2 : 1. One oval tentacle-scale of moderate size. Color in alcohol, nearly white.

"Porcupine" Expedition, 1869, Station 42, southwest of Ireland, 862 fathoms, water 4°.3 Cent., 1 specimen.

The genus is new to North European waters. The species differs from *Ophiochiton lentus*, which comes from 600 fathoms, southeast of the Fijis, in having three long slender arm-spines and only one tentacle-scale.

Ophiacantha Bairdi sp. nov.

Plate V. Figs. 70-72.

Special Marks. — Disk closely and uniformly beset with elongated pointed granules, among which appear a few short scattered spines. Seven or eight slender, smooth, sharp arm-spines. Eleven mouth-papillæ to each angle.

Description of an Individual (Station 340). — Diameter of disk 9.5 mm. Length of arm about 45 mm. Width of arm close to disk 2 mm. Eleven papillæ to each mouth-angle, whereof the outer one on each side is broad and flat, with a rounded cutting edge, and the rest are much narrower and tooth-like, including the odd one at the apex. Five broad flat teeth with a curved cutting edge ; the uppermost one narrower than the others. Mouth-shields small, of a broad oval, or transverse heart-shape ; length to breadth, .8 : 1.2. Side mouth-shields rather large, growing suddenly wider at the outer end, meeting within. Under arm-plates pentagonal, with an obtuse angle within, lateral sides a little re-enteringly curved, and outer side widely curved. Upper arm-plates diamond-shape with the angles much rounded. Side arm-plates rather stout, nearly meeting above and below near base of arm. Near tip of arm the side plates meet broadly above and below, and have only a feeble spine-crest. The upper arm-plates are there three-sided with an angle inward. Disk slightly puffed ; closely and uniformly beset with elongated, pointed grains, among which stand a few scattered short spines. No scaling or radial shields visible. Seven or eight long, slender, pointed, not rough arm-spines. The uppermost one is usually short ; then the next three are as long as two or two and a half joints; the four lowest not much longer than one joint. One large, pointed, longer than broad tentacle-scale. Color in alcohol, nearly white.

Station 308, 41° 24′ 45″ N., 65° 35′ 30″ W., 1242 fathoms. Station 340, 39° 25′ 30″ N., 70° 58′ 40″ W., 1394 fathoms.

The species is quite near *O. vepratica*, from which it is distinguished by having eleven instead of seven mouth-papillæ to each angle, and by the elongated, pointed grains of the disk.

Ophiacantha Bartletti sp. nov.

Plate V. Figs. 73-75.

Special Marks. — Structure delicate, with narrow arms and four smooth, slender arm-spines. A few scattered spines on disk, whose scaling above is scarcely distinguishable. No tentacle-scales.

Description of an Individual. — Diameter of disk 12 mm. Length of arm about 75 mm. Width of arm 2 mm. Five spine-like, spaced mouth-papillæ

on each side, of which four stand on the mouth-frames, and one on the side mouth-shield ; there is in addition a pair which stand at the apex, on the jaw-plate. Five rather thin teeth, shaped like a blunt spear-head. Mouth-shields about as broad as long, of a much-rounded diamond-shape, with a sharp angle within; length to breadth, 1.6 : 1.6. Side mouth-shields very narrow within, where they meet, but spreading at their outer end, so as to partly embrace the mouth-shield. Under arm-plates somewhat longer than broad, of an irregular hexagonal form, with a slight notch without; they are small, and occupy not more than a third of the width of the arm. Side arm-plates meeting above and below, clinging close to arm and with a feeble spine-crest. Upper arm-plates about twice as broad as long, of a transverse diamond-shape, with outer angle rounded. Disk sparsely set with short spines, and covered by a skin which hides the thin scales, except here and there. Of radial shields only the outer, rounded ends may be seen, just over the arms. Genital openings large and extending from mouth-shield nearly to margin of disk. Four slender, smooth, tapering, translucent arm-spines, decreasing in length from above downward, the uppermost one being as long as two joints, while the lowest does not exceed one. No tentacle-scales. Color in alcohol, disk pale gray, arms white.

Station 260, 291 fathoms, 1 specimen.

In wanting tentacle-scales this species is especially distinguished. It stands as near to *O. abnormis* as to any other, but differs in having only four arm-spines and in the arrangement of the mouth-papillæ.

Ophiacantha cervicornis sp. nov.

Plate V. Figs. 76-78.

Special Marks. — Mouth-angles elongated and carrying at their base long spiniform papillæ and small peg-like ones at their apex. Arm-spines wide at their base and toothed on the edges. Disk densely beset with short smooth spines.

Description of an Individual (Station 227). — Diameter of disk 10 mm. Width of arm near disk 2.3 mm. Mouth-angle much elongated and bearing on either side, at its base, four long, pointed spiniform papillæ, inside which there are, on either side, five short, pointed tooth-like papillæ, and a pair at the apex. Mouth-shields of a transverse oval shape, with a small peak inward ; length to breadth, 1 : 1.8. Side mouth-shields of moderate width, meeting within, where they form an acute angle. First under arm-plate much wider than long, with lateral corners rounded and a peak within. The plates beyond have a wide axe-shape, in which the body is narrow with an obtuse angle inward ; the lateral sides are deep re-entering curves, and the cutting edge is represented by the broad, curved outer margin. Side arm-plates meeting below and nearly so above, and having a rather feeble spine-crest. The first two upper arm-plates bear a few small tooth-like spines, and are as broad

as long, and bounded without by a gentle curve and within by a deep pointed one. Farther out the plates are more elongated and angular, and soon become long diamond-shape. Disk densely beset with short, rounded, pointed spines, which obscure the underlying scales and radial shields. Five flattened, tapering, pointed arm-spines, the two uppermost about as long as one and a half arm-joints, the three lowest somewhat shorter. They are lightly swollen at their base and bear a few minute thorns on their edges. Tentacle-pores large, and furnished with two long, slender spiniform scales, whereof one stands on the side arm-plate, the other on the under one. Color in alcohol, straw.

Station 148, St. Kitts, 208 fathoms. Station 227, St. Vincent, 573 fathoms.

The elongated mouth-angle bearing numerous papillæ places this species near *O. stimulea* and *O. hirsuta,* but it differs much from both those species, especially in the under arm-plates and tentacle-scales.

Ophiacantha lineolata sp. nov.

Plate VI. Figs. 79-81.

Special Marks. — A group of tooth-papillæ just under the teeth. Upper surface of disk wholly and thickly set with coarse grains and a few short spines. Eight or nine long, translucent, nearly smooth arm-spines.

Description of an Individual. — Diameter of disk 18 mm. Length of arm about 135 mm. Width of arm, without spines, 6 mm. At base of mouth-angle, on either side, are three or four rather long papillæ, whereof the two outer ones are wider and more flat ; the point of the angle is beset by a cluster of a dozen spine-like papillæ which run upward to join the teeth. These last are seven or eight in number, rather narrow, crowded and with a curved cutting edge. Mouth-shields heart-shaped with an angle inward ; length to breadth, 2 : 2. Side mouth-shields small, tapering to a point inward, where they meet. Under arm-plates squarish, wider than long, with lateral sides re-enteringly curved and a feeble angle within. Side arm-plates meeting below, but not above, and forming a stout, not very prominent spine-crest. Upper arm-plates narrow, four-sided; wider without than within ; length to breadth, 1.3 : 1.3. Disk somewhat swollen in interbrachial spaces, thickly set with coarse grains, among which appear a few small spines ; no radial shields visible, their position being granulated like the rest. Genital openings large and extending from mouth-shield to margin of disk. Eight or nine long translucent, nearly smooth arm-spines, decreasing in length from above downward ; their cross-section is oval, and it is only on their edges that they have microscopic prickles ; length of uppermost spine 11 mm. ; of lowest, 4 mm. One large, oval, pointed tentacle-scale on each pore, except the first, which has two. Color in alcohol, pale brown, with white spines and a white line along upper side of arm.

This large and beautiful species has some relation to Ophiocamax in the cluster of tooth-papillæ at the end of the mouth-angle.

Station 148, St. Kitts, 208 fathoms, 1 specimen.

Ophiacantha lævipellis sp. nov.

Plate VI. Figs. 82-84.

Special Marks. — Disk naked, or with a few scattered grains. Side arm-plates meeting above and below. Seven or eight slightly thorny slender arm-spines.

Description of an Individual. — Diameter of disk 4.5 mm. Length of arm about 18 mm. Width of arm, without spines, 1.5 mm. Mouth-angles long and wide, and bearing on each side three spine-like, widely spaced papillæ, while the apex is occupied by the lowest tooth, which, like the four above it, is of a blunt spear-head shape. The first under arm-plate also carries on its inner edge two scale-like papillæ. Mouth-shields small, of a tranverse diamond-form with rounded corners; length to breadth, .7 : .5. Side mouth-shields wide and large, of almost a crescent shape, meeting broadly within. First under arm-plate rounded hexagonal and nearly as large as a mouth-shield; those beyond are widely separated by the side arm-plates, and are more than twice as wide as long, with a curve without and a small peak within. Side arm-plates meeting widely above and below, and forming a strong spine-ridge, which, farther out, becomes so exaggerated as to give the arm a knotted look. Upper arm-plates, beyond the first, of a blunt wedge form, with the point inward. Disk covered with small imbricated scales which are quite naked (in some specimens there are scattered grains). Radial shields pear-seed shaped; length to breadth, .5 : .4. Genital openings large, and extending from the mouth-shield to nearly the margin of disk. Seven or eight glassy, flattened, slightly thorny arm-spines, of which the uppermost is two or two and a half times as long as a joint; from this they grow shorter to the lowest spine, which is no longer than one joint. The uppermost spines on top of arm stand close to each other, on either side of the median line. One small, pointed tentacle-scale. Color in alcohol, pale brown.

Station 232, St. Vincent, 88 fathoms, 12+ specimens.

The figure of the upper surface is drawn from specimens of two varieties, a smooth and a granulated. The former is the more common. This species has some resemblance to *O. serrata*, but has narrower side mouth-shields and much less thorny arm-spines.

Ophiacantha scolopendrica sp. nov.

Plate VI. Figs. 85-87.

Special Marks. — Seven smooth arm-spines, of which the three lowest are much the smallest. Disk with a few scattered smooth grains, and small rounded radial shields.

Description of an Individual. — Diameter of disk 12 mm. Width of arm 3 mm. Six spaced and rather long mouth-papillæ to each angle. Five thick teeth, of a short oval shape. Mouth-shields very short and wide, rudely transverse oval in form ; length to breadth, 1 : 2.5. Side mouth-shields much longer than wide, of nearly equal width except at their outer ends where they taper ; they fully meet within. First under arm-plate of a transverse diamond-shape with rounded angles ; the next two are squarish, with a curved outer side ; those beyond are nearly semicircular, with a slight peak within ; all are narrow, occupying not more than one third the width of the arm. Side arm-plates stout and forming a well-marked spine-ridge ; they meet below and separate all except the first two upper arm-plates ; they, however, do not meet, and there is a pit between their upper ends ; also they are so short as to leave a band on sides of arm quite uncovered. Upper arm-plates transverse oval with somewhat pointed corners ; they are nearly twice as broad as long and cover only about half the width of the arm. Disk-scales very indistinct, except near radial shields, which are separated, small, short and rounded ; length to breadth, 1.3 : 2. Upper surface of disk sparsely set with smooth grains. Lower interbrachial space smooth and apparently with few or no scales. Genital openings large and extending from the mouth-shield to margin of disk. Seven arm-spines, of which the three lowest are very small, microscopically rough, and not longer than half a joint ; while the three uppermost are often as long as one and a half or two joints, stout, nearly cylindrical, and tapering to a blunt point. On some of the basal pores there is a minute tentacle-scale attached at the juncture of under and side arm-plates. Color in alcohol, pale brown.

"Challenger" Expedition, Station 235, 34° 7′ N., 138° E., 565 fathoms. Water 3°.3 Cent. Mud. One specimen.

The species is nearest *O. tuberculosa ;* but has seven instead of three arm-spines.

Ophiacantha anomala ? G. O. Sars.

Station 306, 41° 32′ 50″ N., 65° 55′ W., 524 fathoms.

Ophiacantha bidentata Ljn.

Station 307, 41° 29′ 45″ N., 65° 47′ 10″ W., 980 fathoms. Station 308, 41° 24′ 45″ N., 65° 35′ 30″ W., 1242 fathoms. Station 324, 33° 27′ 20″ N., 75° 53′ 30″ W., 1386 fathoms. Station 338, 38° 18′ 40″ N., 73° 18′ 10″ W., 922 fathoms. Station 339, 38° 16′ 45″ N., 73° 10′ 30″ W., 1186 fathoms. Station 340, 39° 25′ 30″ N., 70° 58′ 40″ W., 1394 fathoms. Station 341, 39° 38′ 20″ N., 70° 56′ W., 1241 fathoms. Station 342, 39° 43′ N., 70° 55′ 25″ W., 1002 fathoms.

Ophiacantha abyssicola G. O. Sars.

Station 309, 40° 11′ 40″ N., 68° 22′ W., 304 fathoms.

Ophiacantha millespina Vll.

Station 303, 41° 34′ 30″ N., 65° 54′ 30″ W., 306 fathoms. Station 306, 41° 32′ 50″ N., 65° 55′ W., 524 fathoms.

Ophiacantha hirsuta Lym.

Station 155, Montserrat, 88 fathoms. Station 156, Montserrat, 88 fathoms. Station 212, Martinique, 317 fathoms. Station 215, St. Lucia, 226 fathoms. Station 223, St. Vincent, 146 fathoms. Station 232, St. Vincent, 88 fathoms. Station 268, Grenada, 955 fathoms. Station 269, St. Vincent, 124 fathoms. Station 273, Barbados, 103 fathoms. Station 293, Barbados, 82 fathoms. Station 300, Barbados, 82 fathoms. Entrance to Port Royal Harbor, Jamaica, 100 fathoms ; sp. ?

Ophiacantha sertata Lym.

Station 148, St. Kitts, 208 fathoms. Station 164, Guadeloupe, 150 fathoms. Station 187, Dominica, 411 fathoms. Station 208, Martinique, 213 fathoms. Station 240, Grenadines, 164 fathoms. Station 241, Grenadines, 163 fathoms. Station 249, Grenada, 262 fathoms. Station 274, Barbados, 209 fathoms. Station 280, Barbados, 221 fathoms. Station 291, Barbados, 200 fathoms. Station 297, Barbados, 123 fathoms.

Ophiacantha vepratica Lym.

Station 151, Nevis, 356 fathoms. Station 204, Martinique, 476 fathoms. Station 205, Martinique, 334 fathoms. Station 226, St. Vincent, 424 fathoms. Station 260, Grenada, 291 fathoms. Station 264, Grenada, 416 fathoms. Station 288, Barbados, 399 fathoms.

NOTES ON OPHIACANTHA.

Ophiacantha scutata Lym.

The numerous individuals brought back by the second "Blake" expedition show some variations from the original figure (Bull. M. C. Z., V. 9, Pl. I. Figs. 1–3). Usually the radial shields are not naked, but beset, like the rest of the disk, with minute stumps. There often is an extra mouth-papilla on each side ; and higher up in the mouth-slit there may be a pair of scales belonging to the second mouth-tentacles. This last feature exists also in *O. cosmica*, a kindred species, but readily distinguished by the wide separation of the lower arm-plates. *O. scutata* has commonly only one tentacle-scale on the first pore, as on those beyond.

Station 134, Santa Cruz, 248 fathoms. Station 147, St. Kitts, 250 fathoms.

Station 148, St. Kitts, 208 fathoms. Station 183, Dominica, 250 fathoms. Station 238, Grenadines, 127 fathoms. Station 239, Grenadines, 338 fathoms. Station 269, St. Vincent, 124 fathoms. Station 281, Barbados, 288 fathoms. Station 291, Barbados, 200 fathoms.

Ophiacantha echinulata Lym.

Sometimes the radial shields cannot be seen, as in the figure (Bull. M. C. Z., V. 9, Pl. I. Figs. 7–9), but are quite hidden by the short disk-spines.

Station 153, Montserrat, 303 fathoms. Station 174, Guadeloupe, 878 fathoms. Station 185, Dominica, 333 fathoms. Station 205, Martinique, 334 fathoms. Station 227, St. Vincent, 573 fathoms. Station 260, Grenada, 291 fathoms.

Ophiacantha pentacrinus Ltk.

A large specimen with a disk of 6 mm. had still only six arm-spines, and in general answered to the description (*O. meridionalis*, Bull. M. C. Z., I. 10, p. 324), except that there were sometimes four, instead of three, mouth-papillæ on a side, and the disk-crotchets were somewhat stouter.

Station 136, Santa Cruz, 508 fathoms. Station 137, Santa Cruz, 625 fathoms. Station 155, Montserrat, 88 fathoms. Station 167, Guadeloupe, 175 fathoms. Station 176, Dominica, 390 fathoms Station 185, Dominica, 333 fathoms. Station 188, Dominica, 372 fathoms. Station 195, Martinique, 502½ fathoms. Station 204, Martinique, 476 fathoms. Station 205, Martinique, 334 fathoms. Station 206, Martinique, 170 fathoms. Station 211, Martinique, 357 fathoms. Station 212, Martinique, 317 fathoms. Station 221, St. Lucia, 423 fathoms. Station 222, St. Lucia, 422 fathoms. Station 226, St. Vincent, 424 fathoms. Station 227, St. Vincent, 573 fathoms. Station 230, St. Vincent, 464 fathoms. Station 260, Grenada, 291 fathoms. Station 280, Barbados, 221 fathoms. Station 288, Barbados, 399 fathoms. Station 291, Barbados, 200 fathoms. Station 299, Barbados, 140 fathoms. Station 320, 32° 33′ 15″ N., 77° 30′ 10″ W., 257 fathoms.

O. cosmica is near this species, but has seldom less than eight arm-spines, while the disk-crotchets are coarser with a crown of more numerous thorns, and the side arm-plates are less prominent.

Ophiacantha stellata Lym.

This species differs from the two last-named in having shorter and more thorny arm-spines (indeed, the upper arm-spines, beyond the basal joints, are often scarcely longer than the lower); in larger upper arm-plates, and more strongly knotted arms ; and in coarser and more thorny stumps on the disk.

Station 155, Montserrat, 88 fathoms. Station 177, Dominica, 118 fathoms. Station 233, St. Vincent, 174 fathoms. Station 249, Grenada, 262 fathoms. Station 253, Grenada, 92 fathoms. Station 262, Grenada, 92 fathoms. Station

269, St. Vincent, 124 fathoms. Station 272, Barbados, 76 fathoms. Station 273, Barbados, 103 fathoms. Station 290, Barbados, 73 fathoms. Station 292, Barbados, 56 fathoms. Station 293, Barbados, 82 fathoms.

Ophiacantha aspera Lym.

Station 100, off Morro Light, 250–400 fathoms. Station 156, Montserrat, 88 fathoms. Station 158, Montserrat, 148 fathoms. Station 166, Guadeloupe, 150 fathoms. Station 171, Guadeloupe, 183 fathoms. Station 219, St. Lucia, 151 fathoms. Station 240, Grenadines, 164 fathoms. Station 241, Grenadines, 163 fathoms. Station 249, Grenada, 262 fathoms. Station 269, St. Vincent, 124 fathoms. Station 283, Barbados, 237 fathoms. Station 290, Barbados, 73 fathoms.

Ophiacantha Troscheli Lym.

Station 269, St. Vincent, 124 fathoms. Station 290, Barbados, 73 fathoms.

Ophiolebes claviger? Lym.

Station 306, 41° 32′ 50″ N., 65° 55′ W., 524 fathoms.

Ophiomitra incisa sp. nov.

Plate VI. Figs. 89, 90.

Special Marks. — Upper interbrachial spaces indented and covered by a double row of large plates. Radial shields large, scarcely depressed, and nearly or quite joined for their whole length. Two or more tentacle-scales on the first pore. Five slightly thorny arm-spines.

Description of an Individual (Station 131). — Diameter of disk 10 mm. Length of arm about 80 mm. Width of arm 3.5 mm. Four or five papillæ on each side of a mouth-angle ; the three inner ones being stout spiniform, while the outermost, which is wedged between the side mouth-shield and first under arm-plate, is thick, flattened and more or less curled upward. Mouth-shields of a transverse diamond-shape, with corners so rounded as often to approach an oval; length to breadth, 1.8 : 1.2. They are thick and horizontal, so that their border stands out quite sharply from the nearly vertical scaling of the interbrachial space. Side mouth-shields wide and short, not extending beyond the lateral corners of the mouth-shields, widest within, where they fully join. First under arm-plate small, of a diamond-shape with a curve without. The rest are five-sided; widest without, where they are curved, and having re-entering laterals and a very feeble angle within. They are separated by a depressed portion of the side arm-plates, which meet below, but not above, near disk, and form prominent spine-crests on the sides of the arms. Upper arm-plates thick, wider than long, bounded by a gentle curve

without, and by a rounded angle or a deep curve within. Disk thick and rising well above the arms, with a very deep constriction and radiating furrow in each interbrachial space. The surface between the furrow and the radial shield is occupied on either side by four large curved plates running diagonally inwards. The central disk is covered by coarse, irregular plates, similar to those of the lower interbrachial spaces. All the upper surface except the radial shields is sparsely set with smooth stumps. Radial shields large and only a little sunken; joined, except at their inner ends, which are separated by a scale; they are rounded without, pointed within; length to breadth, 3.5 : 1.4. Genital openings reaching from the mouth-shield nearly to margin of disk. Five flattened glassy arm-spines which are slightly thorny on their edges; the upper one is much the longest, and may equal three or four joints, thence they decrease to the lowest, which is about the length of a joint. On the first tentacle-pore are three erect, thickened tentacle-scales; on the other pores there is but a single thickened scale. Color in alcohol, pale straw.

Variations. — There sometimes are as many as six scales on the first tentacle-pore; and a small group of papillæ at outer corner of mouth-slit. The greatest number of arm-spines observed was six. It differs from *O. chelys* in having larger radial shields, which are joined and scarcely sunken (not at all in the young), in having three or more scales on the first tentacle-pore, and in more rounded under arm-plates. Most of the specimens mentioned under *O. chelys* (Bull. Mus. Comp. Zoöl., V. 7, p. 153, and 9, p. 231), as brought by the first "Blake" expedition, belong under this species, although one of them had seven spines. I am satisfied that the deep furrows in the disk are natural to the animal, and are not the result of contraction.

Station 124, Santa Cruz, 580 fathoms. Station 131, Santa Cruz, 580 fathoms. Station 175, Dominica, 608 fathoms. Station 190, Dominica, 542 fathoms. Station 204, Martinique, 476 fathoms. Station 205, Martinique, 334 fathoms. Station 211, Martinique, 357 fathoms. Station 214, Martinique, 476 fathoms. Station 222, St. Lucia, 422 fathoms. Station 227, St. Vincent, 573 fathoms. Station 266, Grenada, 461 fathoms. Station 288, Barbados, 399 fathoms.

Ophiomitra exigua? Lym.

Station 100, off Morro Light, 250–400 fathoms. Station 270, St. Vincent, 75 fathoms. Station 296, Barbados, 84 fathoms.

Ophiomitra valida Lym.

Station 119, 18° 12′ N., 64° 55′ W., 1105 fathoms. Station 156, Montserrat, 88 fathoms. Station 157, Montserrat, 120 fathoms. Station 171, Guadeloupe, 183 fathoms. Station 175 (young), Dominica, 611 fathoms. Station 193, Martinique, 169 fathoms. Station 216, St Lucia, 154 fathoms. Station 218, St. Lucia, 164 fathoms. Station 224, St. Vincent, 114 fathoms. Sta-

tion 232, St. Vincent, 88 fathoms. Station 233, St. Vincent, 174 fathoms. Station 239, Grenadines, 338 fathoms. Station 240, Grenadines, 164 fathoms. Station 241, Grenadines, 163 fathoms. Station 269, St. Vincent, 124 fathoms. Station 270, St. Vincent, 75 fathoms. Station 272, Barbados, 76 fathoms. Station 277, Barbados, 106 fathoms. Station 283, Barbados, 237 fathoms. Station 290, Barbados, 73 fathoms. Station 296, Barbados, 84 fathoms. Station 297, Barbados, 123 fathoms. Bartlett, Station 5, 3.3 m. S. E. by E. ½ E. from Santiago de Cuba Light, 288 fathoms. Station 316, 32° 7′ N., 78° 37′ 30″ W., 229 fathoms.

Ophiocamax fasciculata sp. nov.

Plate VII. Figs. 92-94.

Special Marks. — Disk covered with thin, small, smooth scales, of which there are about ten radiating rows in each interbrachial space, and which are beset by scattered, short, thin spines. Radial shields smooth and regular, and joined their whole length.

Description of an Individual (Station 209). — Diameter of disk 15 mm. Width of arms close to disk 4.5 mm. About twenty-three long, smooth, crowded mouth-papillæ to each angle, arranged in two or three tiers. On the upper part of the jaw-plate are about seven very short, blunt teeth, and, below these, usually eight tooth-papillæ arranged in pairs. Often the teeth do not stand immediately one above the other, but partly alternate. Mouth-shields smooth and a little swollen, of a wide heart-shape with a slight lobe outward ; length to breadth, 2 : 2. Side mouth-shields wide and meeting fully within. Under arm-plates wide triangular, with a sharp angle within, rounded lateral corners, and wavy sides. They are considerably swollen near the middle. Side arm-plates stout, with a thick spine-ridge; they meet both above and below. Upper arm-plates much rounded triangular, with the outer margin swollen. Disk thick, flat on top and not constricted in the interbrachial spaces. It is covered with thin, smooth overlapping scales, of which there are ten or twelve radiating rows in each upper interbrachial space. Above, the disk is beset with short, slender, smooth, tapering spines. Radial shields flat and smooth, of a short pear-seed shape, and joined throughout. Length to breadth, 3 : 2. Six long flattened arm-spines bearing thorns on their two edges. The second is often as long as three arm-joints, the third nearly as long as two, and the fourth and fifth a little longer than one, while the uppermost and lowest are shortest of all. Three and sometimes four spine-like tentacle-scales to each pore, standing in a clump and turned inward. Color in alcohol, disk gray; arms pale yellowish.

A very fine specimen from Station 147 had a disk of 20 mm. and arms about 180 mm. long. There were usually but five spines, the uppermost short one being wanting, while the second was sometimes as long as five joints. The disk-scales were thicker than in the type, the basal tentacle-scales longer and

more numerous, and the under arm-plates and spine-ridges more swollen. The disk-spines were few and scattered. *O. fasciculata* stands between *O. vitrea* and *O. hystrix;* but the former has nine arm-spines and the upper arm set with fine points, while the latter has eight arm-spines and much coarser disk-scales bearing coarse thorny stumps.

Station 145, St. Kitts, 270 fathoms. Station 147, St. Kitts, 250 fathoms. Station 148, St. Kitts, 208 fathoms. Station 209, Martinique, 189 fathoms. Station 295, Barbados, 180 fathoms.

Ophiocamax hystrix Lym.

Station 134, Santa Cruz, 248 fathoms. Station 148, St. Kitts, 208 fathoms. Station 157, Montserrat, 120 fathoms. Station 158, Montserrat, 148 fathoms. Station 209, Martinique, 189 fathoms. Station 224, St. Vincent, 114 fathoms. Station 233, St. Vincent, 174 fathoms. Station 238, Grenadines, 127 fathoms. Station 241, Grenadines, 163 fathoms. Station 269, St. Vincent, 124 fathoms. Station 274, Barbados, 209 fathoms. Station 280, Barbados, 221 fathoms. Station 291, Barbados, 200 fathoms. Bartlett, Station 5, 3.3 m. S. E. by E. $\frac{1}{2}$ E. from Santiago de Cuba Light, 228 fathoms. Bartlett, Station 29, 21° 23′ 19″ N., 82° 54′ 42″ W., 300 fathoms.

Ophiothamnus vicarius Lym.

Station 100, off Morro Light, 250–400 fathoms. Station 175 (young), Dominica, 611 fathoms. Station 190, Dominica, 542 fathoms (young), sp.? Plate VI. Fig. 88. Station 204, Martinique, 476 fathoms. Station 315, 32° 18′ 20″ N., 78° 43′ W., 225 fathoms. Station 316, 32° 7′ N., 78° 37′ 30″ W., 229 fathoms.

OPHIOCOPA * gen. nov.

Disk covered with fine imbricated scales, which may bear grains; and small radial shields. Numerous close-set mouth-papillæ, with teeth but no tooth-papillæ. Side arm-plates nearly meeting above and below. Some of the arm-spines flattened and widened like an oar-blade. Two long genital openings in each interbrachial space.

Ophicopa spatula sp. nov.

Plate VII. Figs. 95-98.

Special Marks. — Five arm-spines, which, near base of arm, are flat and all more or less widened. Five papillæ on each side of a mouth-angle, whereof the outermost is widest. Granules on upper margin of disk.

Description of an Individual. — Diameter of disk 9 mm. Width of arm

* ὄφις, snake; κώπη, oar.

near disk 2 mm. Five crowded mouth-papillæ on either side of an angle, whereof the four innermost are small and narrow, while the outermost one is as wide as three of them. Four teeth, of which the upper and the under one are more or less pointed, while the other two are wide with a curved cutting edge. Mouth-shields of a wide diamond-shape with rounded angles; length to breadth, 1.5 : 1.5. Side mouth-shields long and tapering inward to a point; their outer end widened so as to embrace a corner of the mouth-shield. Under arm-plates much wider than long, of a broad shield-shape, with a wide curve without, re-entering curves on the sides, and a very obtuse angle within. Side arm-plates not prominent, nearly or quite meeting above and below. Upper arm-plates much wider than long, transverse diamond-shape with lateral angles sharp. Disk covered with smooth flat imbricated scales, the largest 1 mm. long; between the radial shields, in interbrachial space, there are four or five radiating rows. Along margin of disk is an irregular line of granules. Radial shields rounded, a little swollen, about as broad as long, closely joined; length to breadth, 1.5 : 1.5. Genital openings large and extending from mouth-shield to margin of disk. Five arm-spines, whereof the lowest is shortest, about as long as one arm-joint, and blunt and flattened; the two uppermost are also flattened, but sharp, and about as long as two joints; the two middle ones are, near base of arm, much flattened, and are widened at their tip like a spatula and microscopically serrated on their edges: farther out, they are simply wide and flat. Two oval, rather large tentacle-scales to each pore. Color in alcohol, gray.

"Challenger" Expedition, Station 219, 1° 50′ S., 146° 42′ E., 150 fathoms, mud. One specimen.

Ophiothrix Suensonii Ltk.

Station 127, Santa Cruz, 38 fathoms. Station 142, Flannegan Passage, 27 fathoms. Station 152, St. Kitts, 122 fathoms. Station 155, Montserrat, 88 fathoms. Station 156, Montserrat, 88 fathoms. Station 157, Montserrat, 120 fathoms. Station 189, Dominica, 84–120 fathoms. Station 247, Grenada, 170 fathoms. Station 249, Grenada, 262 fathoms. Station 262, Grenada, 92 fathoms. Station 269, St. Vincent, 124 fathoms. Station 272, Barbados, 76 fathoms. Station 276, Barbados, 94 fathoms. Station 277, Barbados, 106 fathoms. Station 285, Barbados, 13–40 fathoms. Station 286, Barbados, 7–45 fathoms. Station 290, Barbados, 73 fathoms. Station 292, Barbados, 56 fathoms. Station 293, Barbados, 82 fathoms. Station 294, Barbados, 137 fathoms. Station 298, Barbados, 120 fathoms.

Ophiothrix angulata Ayres.

Station 142, Flannegan Passage, 27 fathoms. Station 152, St. Kitts, 122 fathoms. Station 155, Montserrat, 88 fathoms. Station 156, Montserrat, 88 fathoms. Station 177, Dominica, 118 fathoms. Station 203, Martinique,

96 fathoms. Station 241, Grenadines, 163 fathoms. Station 246, Grenada, 154 fathoms. Station 247, Grenada, 170 fathoms. Station 249, Grenada, 262 fathoms. Station 285, Barbados, 13–40 fathoms. Station 292, Barbados, 56 fathoms. Bartlett, Station 30, 21° 26′ 30″ N., 86° 28′ 40″ W., 51 fathoms. Bartlett, entrance to Port Royal, Jamaica, 100 fathoms.

Ophioscolex tropicus Lym.

Station 195, Martinique, 502½ fathoms. Station 266, Grenada, 461 fathoms. Station 211, Martinique, 357 fathoms. Station 273, Barbados, 103 fathoms.

Young specimens resemble the young of *O. purpureus*, but have much more regular mouth-papillæ and flatter arm-spines.

Ophioscolex glacialis Müll. & Tr.

Station 336, 38° 21′ 50″ N., 73° 32′ W., 197 fathoms.

From the following three stations, lying much farther to the south, there were specimens having shorter and more numerous mouth-papillæ, and much thinner skin. I prefer to consider them as varieties, until additional specimens shall prove their final relations.

Station 185, Dominique, 333 fathoms (young). Station 274, Barbados, 209 fathoms (young). Station 293, Barbados, 82 fathoms (young).

OPHIOTOMA* gen. nov.

Disk covered by a thick, naked skin, which conceals the small shapeless radial shields. Numerous mouth-papillæ and teeth; no tooth-papillæ. Arm-spines hollow, as in Ophiacantha, and smooth. Upper arm-plates present. Two genital openings in each interbrachial space.

The genus may be called an Ophioscolex with upper arm-plates and hollow arm-spines.

Ophiotoma coriacea sp. nov.

Plate II. Figs. 1-3.

Special Marks. — A dozen spiniform or tooth-like papillæ to each mouth-angle, besides two minute ones under each of the second mouth-tentacles. Five smooth, slender, tapering arm-spines.

Description of an Individual. — Diameter of disk 16 mm. Width of arm near disk 3 mm. Mouth-angle elongated and bearing about a dozen papillæ, whereof the outer ones incline to be spiniform, while those within are somewhat more flattened and tooth-like. The second mouth-tentacle has also a couple of minute spiniform scales, which stand on the side mouth-shields. Seven or eight stout, flat spear-head-shaped teeth. Mouth-shields wide triangular with rounded corners; length to breadth, 2.5 : 1.5. Side mouth-

* ὄφις, snake; τομή, a cut.

shields narrow within and not quite meeting, while without they spread inward to the first under arm-plate, and upward round the corner of the mouth-shield to the head of the genital opening. Under arm-plates small, about as broad as long; shield-shaped with a feeble angle inward; length to breadth, 1.2 : 1.2. Side arm-plates flat with an ill-marked spine-crest at their outer margin; they meet below, but not above. Upper arm-plates wider than long, hexagonal with outer and inner angles rounded, and lateral angles sharp. Disk rather thick and covered by a tough skin, which exhibits obscurely below a fine scaling, and above a few very minute, scattered spines. Over each side of the arms is a swelling which looks like a radial shield, but is really the head of the large genital plate, the small radial shield being wholly hidden under the skin. Genital openings large, and extending from mouth-shield to margin of disk. Five slender, delicate, tapering, rounded hollow arm-spines. No tentacle-scales outside the mouth. Color in alcohol, disk greenish; arms pale brown.

Station 308, 41° 24′ 45″ N., 65° 35′ 30″ W., 1242 fathoms, 1 specimen.

Ophiosciasma granulatum sp. nov.

Plate VII. Figs. 99-102.

Special Marks. — Minute papillæ on edges of mouth-angles. Arms flat and rather wide. Two flat, translucent arm-spines with rough edges.

Description of an Individual. — Diameter of disk 6 mm. Arms very low and flat; width near disk 1.2 mm. Mouth-angles rather large, and bearing on their edges a row of minute saw-like papillæ; the two or three at the apex are somewhat larger. Mouth-shields small and rounded, with a slight angle inward; length to breadth, .7 : .7. Side mouth-shields wide and fully meeting within. Under arm-plates rather thick, longer than broad, wider without than within, and with deep re-entering curves on the sides, where are the tentacle-pores. Side arm-plates projecting in a strong spine-ridge, meeting neither above nor below. The upper surface, covered only by a thin skin, shows distinctly the tops of the elongated arm-bones with the pairs of circular muscle-fields between them. Farther out on the arm there appears a central depression, which towards the end penetrates quite through, until, at the tip, the bone appears as two long slender pieces curving towards each other, and uniting at either extremity. Disk covered with skin having scattered grains on its surface, which are opaque white. No scales or radial shields are visible. Two translucent rough arm-spines, a little longer than a joint, and standing at a strong angle to the arm. They are composed of two flattened spicules soldered together, each of which has two or three spurs on its free edge (Fig. 101), and are enclosed in a skin-bag. Tentacles simple, fleshy, and very thick. No tentacle-scales. Color in alcohol, pale yellowish, with yellow tentacles.

A larger specimen with a disk of 10 mm. had arms 45 mm. long; but did not differ except in having many of the disk granules buried in the thick skin.

Station 203, Martinique, 96 fathoms, 1 specimen. Bartlett, entrance to Port Royal, Jamaica, 100 fathoms, 1 specimen.

The species is readily distinguished from *O. attenuatum* by much wider arms, and by two instead of three arm-spines.

Ophiogeron supinus sp. nov.

Plate VII. Figs. 103-106.

Special Marks. — Arms very flat and covered with thick, loose skin. Two glassy, slender, smooth arm-spines enclosed in a common skin-bag.

Description of an Individual. — Diameter of disk 18 mm. Length of arm about 85 mm. Width of arm near disk 5 mm. Height of arm 2.5 mm. On either side of the large mouth-angle is an irregular row of minute, conical papillæ; a cluster of similar tooth-papillæ stands on the jaw-plate; and, above these, are small, spine-like teeth. Mouth-shields small, as broad as long, presenting an angle within and a curve without. Side mouth-shields long and pretty wide; fully meeting within; and, at their outer ends, extending much beyond the mouth-shield. At base of arm all plates are quite obscured by skin; but at the tip may be seen small under arm-plates, longer than broad, and pentagonal, with re-entering lateral sides and an angle within. The side arm-plates then meet below, but do not encroach on the upper surface. As there are no upper plates, the arm-bone may be seen, divided into its two embryonic halves. Disk uniformly covered by a soft, naked, wrinkled skin, which was much torn in the specimens observed. Genital openings long and large, extending from mouth-shield to margin of disk. Two glassy, smooth, slender arm-spines, longer than a joint, and enclosed in a common skin-bag. No tentacle-scales. Color in alcohol, pale brown.

Station 148, St. Kitts, 208 fathoms, 2 specimens. Station 291, Barbados, 200 fathoms. Station 230, St. Vincent, 464 fathoms (young).

The long flat arms covered by loose skin readily distinguish this species from *O. edentulus.*

There are, under the skin, just over the arms, small rounded radial shields, and, articulated to them, very short genital scales and plates, very much as in Ophiobyrsa. In the substance of the skin are imbedded fine scales, especially near the disk margin.

Ophiohelus umbella Lym.

Station 300, Barbados, 82 fathoms.

Ophiomyces mirabilis Lym.

Station 222, St. Lucia, 422 fathoms.

Ophiomyces frutectosus Lym.

Station 281, Barbados, 288 fathoms. Station 282, Barbados, 154 fathoms.

Ophiobyrsa Perrieri sp. nov.

Plate II. Figs. 4-6.

Special Marks. — Skin of disk naked, except clumps of short spines over the radial shields. No spines on upper side of arms.

Description of an Individual. — Diameter of disk 22 mm. Length of arm 270 mm. Width of arm close to disk 4 mm. The mouth-angles, which are covered with thick skin, have a few short spiniform papillæ at the apex, arranged chiefly on the jaw-plate. Mouth-shields and other plates about the mouth quite obscured by thick skin. Top of arm covered also by a very thick, tough skin, but destitute of anything like upper arm-plates, except a certain amount of thin lime-crust, underlying it. Under arm-plates swollen, rounded, about as long as broad, and broader without than within. They are obscured by the overlying skin. Side arm-plates like little flaps or pads inclining outward. Disk rounded and wrinkled, covered by a thick skin which is naked except over the radial shields where are clusters of very short, blunt spines. Six equal, short, blunt arm-spines, not as long as a joint; when stripped of the thick covering skin, they are rough and translucent. Tentacles large and simple. No tentacle-scales. Color in alcohol, light yellowish brown.

Bartlett, 3.3 m. S. E. by E. ½ E. from Santiago de Cuba Light, 288 fathoms, 1 specimen.

Ophiobyrsa serpens sp. nov.

Plate VIII. Figs. 117-119.

Special Marks. — Three short, glassy, slightly thorny arm-spines covered by thick skin. Mouth-angle long and bearing a line of minute papillæ on either side.

Description of an Individual. — Diameter of disk 16 mm. Length of arm (from another specimen) above 140 mm. Width of arm near disk 2.8 mm. On either side of the inner part of each mouth-angle is a line of about five minute papillæ covered by thick skin. Five small, spine-like teeth, of which the uppermost are longest. A thick skin hides mouth-shields, side mouth-shields, and under arm-plates. Side arm-plates project like little flaps. Disk covered by a naked, wrinkled skin; along its margin runs a row of minute peg-like spines, of which there is also a radiating row over the place of each radial shield. Genital openings large and extending from the region of the mouth-shield to margin of disk. Three short, glassy, slightly thorny arm-spines, of which the lowest is longest and about as long as a joint; they are covered by skin. No tentacle-scales. Color in alcohol, above, umber variegated with yellowish brown; below, similar but lighter.

Station 278, 69 fathoms, 2 specimens.

O. serpens differs from *O. Perrieri* in having three arm-spines instead of five; and in longer mouth-angles with minute papillæ. The fact that it preserves

its color in alcohol suggests that it lives also in shallow water, although now found for the first time in 69 fathoms.

Ophiobyrsa hystricis sp. nov.

Plate VIII. Figs. 120-122.

Special Marks. — At apex of mouth-angle two or three large, peg-like mouth-papillæ; and two or three others much smaller, on either side, arranged in a line which runs high up on the side of the angle. Five slim, glassy arm-spines covered with skin.

Description of an Individual. — Diameter of disk 20 mm. Length of arm 187 mm. Width of arm near disk 5.5 mm. Height of arm 3 mm. The somewhat long and narrow mouth-angle bears at its end a pair of stout, peg-like papillæ, and sometimes a third standing above them; on either side of the angle, considerably above its lower edge, is a line of three similar but much smaller papillæ. Mouth-shields and side mouth-shields entirely hidden by skin, as are the plates of the arm. On removing the skin, the under arm-plates are seen to be about 1 mm. long and squarish, with outer corners cut off. Side arm-plates like ridges, tapering at both ends, and with their lower end a little inserted between the under plates. There is nothing to represent upper arm-plates except two small nodules, one on each side of the median line. These are homologous with the double row of spine-bearing tubercles found in *O. rudis*. Disk thick and swollen, and covered by a tough skin; its upper surface is sparsely set with very short spines, more numerous and longer over the region of the radial shields, but all covered and obscured by the disk-skin. Genital openings large, and nearly extending to margin of disk. Five slender, slightly rough, glassy, nearly equal arm-spines, about as long as one and a half arm-joints. They are covered by thick skin. Very large fleshy tentacles, but no tentacle-scales. Color in alchol, pale straw, with yellow tentacles.

"Porcupine" Expedition, 1869, Station 65, northwest of Shetland Islands, 345 fathoms, water 1°.7 Cent.

This is the species mentioned by Sir Wyville Thomson on page 123 of the "Depths of the Sea." It comes from the "cold area," where the sea is at or below the freezing point of fresh water; whereas the three other species, *O. rudis*, *O. serpens*, and *O. Perrieri*, from Australia and the West Indies, inhabit much warmer water. By its small papillæ on the sides of the mouth-angles this species differs from the typical Ophiobyrsa and approaches Ophioscolex; the joints of the arm-bones are, however, essentially as in Ophiobyrsa.

Ophiomyxa tumida sp. nov.

Plate I. Figs. 1-3.

Special Marks. — Four or five slender, tapering, slightly rough arm-spines. Only a trace of upper arm-plates. Radial shields small and not bedded in a cluster of scales. A single marginal line of small plates round the disk.

Description of an Individual (21° 23′ 19″ N., 82° 54′ 42″ W.). — Diameter of disk 13 mm. Width of arm close to disk 3 mm. Length of arm 95 mm. Four flat, rounded papillæ with rough cutting edges on each side of the mouth-angles; and five or six teeth of similar form, but with nearly smooth edges. Mouth-shields showing indistinctly under the skin as transverse oval figures. On boiling the skin of the arm in potash there are found under arm-plates of a shield-shape, with a strong central notch and two angles on the outer side and a peak within; while the side arm-plates are seen as ridges nearly meeting below, where they are thickest, and have a notch in their outer side through which passes the tentacle. Only a trace of upper plates in form of little crusts of lime. Disk five-sided with re-entering curves; covered by a naked, loose, wrinkled skin, under which is found a continuous marginal line of small plates, which runs quite round the entire edge. Attached by their outer ends to this line of plates are small, short, club-shaped radial shields, which have no such cluster of small scales as are often found in the genus. Four or five slender, somewhat flattened, blunt, slightly rough arm-spines, about as long as a joint. No tentacle-scales. Color in alcohol, disk gray; arms straw.

Usually this genus has low side arm-plates, and a high arch of separate pieces which represent the upper arm-plates. The latter are nearly wanting in *O. tumida*, while the side arm-plates run somewhat farther upwards than common.

Two other lots from Stations 319, 32° 25′ N., 77° 42′ 30″ W., 262 fathoms, and 320, 32° 33′ 15″ N., 77° 30′ 10″ W., 257 fathoms, may be the young of this species. The specimens differed in having, with a disk of 9 mm., two, or at most three, arm-spines. The radial shields were as in *O. tumida*, but there was no well-marked marginal line of plates. There were, however, microscopic crust-like scales under the disk skin, which may also be detected in *O. tumida*. The specimens were fertile and were viviparous.

Station 132, Santa Cruz, 115 fathoms. Station 139, Santa Cruz, 218 fathoms. Station 146, St. Kitts, 245 fathoms. Station 147, St. Kitts, 250 fathoms. Station 148, St. Kitts, 208 fathoms. Station 155, Montserrat, 88 fathoms. Station 156, Montserrat, 88 fathoms. Station 157, Montserrat, 120 fathoms. Station 158, Montserrat, 148 fathoms. Station 165, Guadeloupe, 277 fathoms. Station 172, Guadeloupe, 62–180 fathoms. Station 177, Dominica, 118 fathoms. Station 203, Martinique, 96 fathoms. Station 205, Martinique, 334 fathoms. Station 220, St. Lucia, 116 fathoms. Station 231, St. Vincent, 95 fathoms. Station 232, St. Vincent, 88 fathoms. Station 238, Grenadines, 127 fathoms. Station 241, Grenadines, 163 fathoms. Station 246, Grenada, 154 fathoms. Station 247, Grenada, 170 fathoms. Station 259, Grenada, 159 fathoms. Station 269, St. Vincent, 124 fathoms. Station 272, Barbados, 76 fathoms. Station 273, Barbados, 103 fathoms. Station 276, Barbados, 94 fathoms. Station 278, Barbados, 69 fathoms. Station 281, Barbados, 288 fathoms. Station 285, Barbados, 13–40 fathoms. Station 290, Barbados, 73 fathoms. Station 291, Barbados, 200 fathoms. Station 296, Barbados,

84-125 fathoms. Bartlett, 21° 23′ 19″ N., 82° 54′ 42″ W., 300 fathoms. Santiago de Cuba, 288 fathoms. Station 319, 32° 25′ N., 77° 42′ 30″ W., 262 fathoms. Station 320, 32° 33′ 15″ N., 77° 30′ 10″ W., 257 fathoms.

Ophiomyxa serpentaria sp. nov.

Plate VIII. Figs. 114-116.

Special Marks. — Three short, tapering, blunt, translucent arm-spines enclosed in skin-bags. Three small mouth-papillæ on either side of the mouth-angle, near its apex. Under and side arm-plates soldered together. No upper arm-plates. Skin of disk without apparent scales and with only small radial shields.

Description of an Individual. — Diameter of disk 19 mm. Length of arm 50 mm. Width of arm near disk 3 mm. On either side of each mouth-angle, near its apex, are three mouth-papillæ, of the usual flattened form with saw-like edge. The innermost one is largest; the two outer ones are smaller, and more or less obscured by thick skin. Teeth similar to innermost mouth-papilla. Mouth-shields and side mouth-shields wholly hidden by thick skin. On removing the skin there are seen under arm-plates of elongated shape with deep re-entering curves on their sides where are the tentacle-pores; they are soldered together and with the side arm-plates, and have on their upper surface four knobs for attachment to the arm-bones. Side arm-plates thick and shapeless, extending to the upper surface of the arm. No upper arm-plates. Disk covered by a smooth tough skin, which under the microscope is seen to be full of little, rounded, thin scattered scales. There is no marginal row of plates; and the very small radial shields, which lie in the angle made by the arm with the disk, have no bed of scales. Genital openings running from mouth-shields rather more than half-way to margin of disk. Three arm-spines about 1.7 mm. long, widely spaced and standing at a large angle with the arm; their base is enclosed by thick skin, which being stripped off, they appear cylindrical tapering, blunt, and translucent; under the microscope they are slightly rough. Tentacles large and fleshy, but without scales. The articulating faces of the arm-bones do not approach the Astrophyton form so much as do those of other members of the genus, but come nearer the type of the true Ophiurans.

"Porcupine" Expedition, Station 54, between Færoë Islands and Hebrides, 363 fathoms, water 0°.3 Cent., 1 specimen.

The under arm-plates are shaped somewhat like those of *O. vivipara*, while the disk-skin, almost without lime-scales, reminds one of *O. australis*. The absence of upper arm-plates marks this new species as the Northern correspondent of the Antarctic *O. vivipara*, which is plentiful; and it is therefore singular that only one specimen of the Northern representative should thus far have been found.

Ophiochondrus crassispinus sp. nov.

Plate VII. Figs. 111-113.

Special Marks. — Seven or eight thick, short, blunt, slightly rough arm-spines. Radial shields long and prominent. Mouth-papillæ sharp and separated.

Description of an Individual. — Diameter of disk 6 mm. Length of arm 20 mm. Width of arm close to disk 2 mm. Three short, stout, sharp mouth-papillæ on each side of an angle, and one similar but larger at the apex; this last may be considered as the lowest tooth. Mouth-shields somewhat swollen, about as broad as long, with an angle inward. Side mouth-shields large, thick and wide; broader without than within where they meet. First under arm-plate small, longer than broad, with an angle inward. Those beyond are separated one from another, and are four-sided and much wider than long, with a slight re-entering curve without. Side arm-plates with narrow, prominent spine-ridges; meeting below but separated above by fan-shaped upper arm-plates which present a truncated angle inward. Disk thick, sparsely beset with a fine granulation, except on the radial shields which are prominent and large; they are much longer than broad, wider without than within, and separated; their ends are rounded; length to breadth, 2 : .6. Seven or eight short, blunt, slightly rough arm-spines, which stand at a considerable angle to the arm; they are nearly equal and not so long as a joint; those in the middle often are swollen at their base. No tentacle-scales. Color in alcohol, pale straw.

Station 316, 32° 7′ N., 78° 37′ 30″ W., 229 fathoms, 1 specimen.

This species is well distinguished from *O. stelliger* by its great naked radial shields and numerous arm-spines; and from *O. convolutus* by different mouth-papillæ and no tentacle-scale.

Ophiochondrus squamosus.

Plate VII. Figs. 108-110.

Special Marks. — Disk covered above by thick, lumpy, separated plates, and below by lumpy scales. Seven or eight short conical arm-spines. Lower arm-plates obscured by thick skin.

Description of an Individual. — Diameter of disk 6.5 mm. Length of arm 40 mm. Width of arm near disk without spines 1.3 mm. Three small, somewhat flattened, separated papillæ on each side of a mouth-angle, whose apex is occupied by the lowest tooth, which is large and of a wide spear-head shape. Mouth-shields small, of a transverse oval form; length to breadth, .5 : .6. Side mouth-shields scarcely visible under the thick skin; they are narrow and meet within. Basal under arm-plates obscured by thick skin; farther out on arm, they appear as thick, widely separated transverse oval plates, and near the end they are squarish and nearly or quite touch each other. Side arm-

plates projecting as narrow spine-crests, and meeting neither above nor below. Upper arm-plates much wider than long, transverse oval, thick and microscopically tuberculated; length to breadth, .5 : .9. Disk rather thick and covered above by high, lumpy, irregular, microscopically tuberculous plates, which are widely separated by depressed lines. Interbrachial spaces below covered by lumpy scales. Radial shields pear-seed-shape, small, and separated by a single row of plates; length to breadth, 1 : .5. Seven or eight (sometimes only six) short, stout, conical, equal arm-spines, about as long as a joint. Two minute, rounded tentacle-scales. Color in alcohol, nearly white; tentacles brownish.

Station 147, St. Kitts, 250 fathoms, 1 specimen.

At first sight this species seems like a new genus, owing to its peculiar disk covering; but I do not doubt it belongs under Ophiochondrus, although I have had no chance to examine the arm-bones.

Ophiochondrus convolutus Lym.

Station 100, off Morro Light, 250–400 fathoms. Station 208, Martinique, 213 fathoms. Station 219, St. Lucia, 151 fathoms. Station 224, St. Vincent, 114 fathoms. Station 232, St. Vincent, 88 fathoms. Station 233, St. Vincent, 174 fathoms. Station 238, Grenadines, 127 fathoms. Station 253, Grenada, 92 fathoms. Station 254, Grenada, 164 fathoms. Station 269, St. Vincent, 124 fathoms. Station 280, Barbados, 221 fathoms.

Hemieuryale tuberculosa sp. nov.

Plate VIII. Figs. 123-127.

Special Marks. — Upper arm-plate persistent to base of arm and there surrounded by large grains or tubercles. Two short flattened arm-spines which grow larger towards their ends.

Description of an Individual (Station 203). — Diameter of disk 6.5 mm. Length of arm 37 mm. Width of arm near disk 2 mm. Three or four small, close-set, bead-like papillæ on each side of a mouth-angle, and just above its apex appears the lowest of the short, thick rounded teeth. Mouth-shields small and five-sided, with rounded corners and an angle inward; length to breadth, 1 : 1. Side mouth-shields ovoid and swollen, nearly as large as mouth-shields, and like them microscopically tuberculous. Under arm-plates swollen and soldered with surrounding parts, so that their outlines are indistinct; small, rounded, and separated from one another. Side plates a little swollen, meeting below, but rising only about half-way up the side of the arm. At its tip however they meet broadly above, where there is a small bead-like upper arm-plate. A few joints farther in, it becomes larger and has a supplementary piece at either corner, and a granule inside it, in the centre, and separating the side arm-plates (Fig. 127). Still farther in, the upper arm-plates

have a transverse oval shape, and are separated by a group of five tubercles arranged in two rows, while the supplementary corner piece has become as large as the plate (Fig. 126). At the base of the arm the same arrangement prevails; but the upper plate is proportionately smaller and less regular, while the intermediate tubercles, from three to five in number, are conspicuous (Fig. 125). Disk small, and strongly contracted in the interbrachial spaces. It is covered by large radial shields which are much longer than wide and microscopically tuberculous; length to breadth, 2.2 : 1. In the centre of the disk is a five-sided space covered by closely soldered plates and tubercles, from which radiate five brachial and five interbrachial narrow spaces; the latter covered by plates, the former by plates bearing large tubercles. Lower interbrachial spaces covered by small, swollen, closely soldered plates. Two short, stout, flattened arm-spines not more than half as long as a joint, and growing wider at the end. At tip of arm there is but one spine. One round tentacle-scale. Color in alcohol, above variegated with shades of yellowish brown and with some of the tubercles white; below lighter with a broad longitudinal arm-band of purplish.

Station 132, Santa Cruz, 115 fathoms. Station 203, Martinique, 96 fathoms.

This species, with the top of its arm covered by polished beads of various colors, presents a curious aspect. It is readily distinguished from *H. pustulata* by the persistence of the upper arm-plate; and by having tubercles, instead of of a smooth mosaic, on the upper side of the arm.

Hemieuryale pustulata Lym.

Station 132, Santa Cruz, 115 fathoms. Station 203, Martinique, 96 fathoms. Station 276, Barbados, 94 fathoms. Station 277, Barbados, 106 fathoms. Station 296, Barbados, 94 fathoms.

Sigsbeia murrhina Lym.

Station 132, Santa Cruz, 115 fathoms. Station 155, Montserrat, 88 fathoms. Station 156, Montserrat, 88 fathoms. Station 157, Montserrat, 120 fathoms. Station 166, Guadeloupe, 150 fathoms. Station 203, Martinique, 96 fathoms. Station 209, Martinique, 189 fathoms. Station 210, Martinique, 191 fathoms. Station 211, Martinique, 357 fathoms. Station 219, St. Lucia, 151 fathoms. Station 220, St. Lucia, 116 fathoms. Station 222, St. Lucia, 422 fathoms. Station 224, St. Vincent, 114 fathoms. Station 232, St. Vincent, 88 fathoms. Station 233, St. Vincent, 174 fathoms. Station 238, Grenadines, 127 fathoms. Station 241, Grenadines, 163 fathoms. Station 247, Grenada, 170 fathoms. Station 249, Grenada, 262 fathoms. Station 269, St. Vincent, 124 fathoms. Station 277, Barbados, 106 fathoms.

OPHIOBRACHION gen. nov.*

Entire animal clothed in a thick skin which hides the underlying plates and is beset on the disk with spines. Arms long, slender and serpentine. Upper arm-plates wanting. Side arm-plates forming a low ridge with a line of little mamelons each bearing a hooklet which answers to an arm-spine. Tentacles large and simple. Mouth-angles rounded, covered with thick skin and bearing at their apex a clump of spiniform papillæ. Two large genital openings in each interbrachial space.

The presence of hooklets, which replace the arm-spines *quite to the base of the arm*, is a feature found in no other Ophiuran; and, indeed, in none of the Astrophytons; for the hooklets of these, when found at the base of the arm, are not homologous with arm-spines, because they do not stand on the side arm-plate. At the tip of the Astrophyton arm there are, however, strictly homologous spines, like compound hooks, but these, as they approach the base of the arm, change gradually to short thick spines, or tentacle-scales, as they may also be called. (See Bull. M. C. Z., VI. 2, Plate XIX. Figs. 493–495.) As might be expected, the joints between the arm-bones are on the modified hour-glass pattern, similar to that found in Sigsbeia, and therefore approaching the corresponding structure among Astrophytons. In a word, this new genus belongs with such genera as Ophiomyxa and Ophiobyrsa, and stands nearest the simple-armed Astrophytons.

Ophiobrachion uncinatus sp. nov.

Plate VIII. Figs. 128-131.

Special Marks. — Arms six or seven times the diameter of disk. Seven or eight compound hooklets mounted on little cylindrical bases which rise from the side arm-plates.

Description of an Individual. — Diameter of disk 43 mm. Length of arm 270 mm. Width of arm close to disk 5 mm. Mouth-angle covered with thick skin and bearing at the apex an irregular clump of short, sharp spines, like prickles. All the mouth-shields obscured by thick skin, except the madreporic, whose transverse oval outline may be distinguished. It has a few irregular pores near its outer margin. Under arm-plates obscured by a thick skin, on removing which they are found to be of a rounded quadrangular form, wider without than within, swollen, and sometimes so cut out on the lateral sides, where the tentacles pass through, as to assume an axe-shape. They are continued upward by shapeless, rounded side arm-plates, which appear externally as well-marked spine-ridges, bearing a row of seven or eight small cylindrical knobs, each with a hole in its top to which is articulated a hooklet. The lowest knob is opposite the tentacle. No upper arm-plates; there are,

* ὄφις, snake; βραχίων, arm.

however, two little lime nodules bedded in the skin of that region, over each joint. Disk large and flat, covered by a thick, somewhat wrinkled skin, densely beset above and below by short spines, whose bases are enclosed in a sheath of skin, beyond which projects a sharp, translucent point, or a fork. The arm-spines are represented by a row of seven or eight minute compound hooklets, about 1 mm. long. They are translucent and end in a sharp hook, and have two or three curved spurs on the same side. At the very tip of the arm the structure does not vary, except that the hooklets with their knob-like bases are reduced to two. The large smooth tentacles have no special scales. Color in alcohol, disk light yellowish brown; arms paler.

Bartlett, south side of Cuba, 19° 48′ 47″ N., 77° 23″ W., 250 fathoms, 1 specimen.

Astrophyton cœcilia Ltk.

Station 269, St. Vincent, 124 fathoms. Station 290, Barbados, 73 fathoms. Station 296, Barbados, 84 fathoms.

Gorgonocephalus mucronatus Lym.

Bartlett, Station 5, 3.3 m. S. E. by E. $\frac{1}{2}$ E. from Santiago de Cuba Light, 288 fathoms. Station 139, Santa Cruz, 218 fathoms, var. ? Station 269, St. Vincent, 124 fathoms, var. ?

Astrocnida isidis Lym.

Station 156, Montserrat, 88 fathoms. Station 290, Barbados, 73 fathoms. Station 292, Barbados, 56 fathoms. Station 296, Barbados, 84 fathoms. Station 298, Barbados, 120 fathoms.

Astrogomphus vallatus Lym.

Station 209, Martinique, 189 fathoms. Station 224, St. Vincent, 114 fathoms. Station 232, St. Vincent, 88 fathoms. Station 269, St. Vincent, 124 fathoms. Station 318, 31° 48′ 50″ N., 77° 51′ 50″ W., 337 fathoms.

Astroporpa annulata Örst. & Ltk.

Station 132, Santa Cruz, 115 fathoms. Station 155, Montserrat, 88 fathoms. Station 178, Dominica, 130 fathoms. Station 203, Martinique, 96 fathoms. Station 241, Grenadines, 163 fathoms. Station 253, Grenada, 92 fathoms. Station 272, Barbados, 76 fathoms. Station 273, Barbados, 103 fathoms. Station 276, Barbados, 94 fathoms. Station 277, Barbados, 106 fathoms. Station 290, Barbados, 73 fathoms. Station 292, Barbados, 56 fathoms. Station 296, Barbados, 84 fathoms. Station 297, Barbados, 123 fathoms. Station 298, Barbados, 120 fathoms. Bartlett, Station 20, off entrance to Port Royal, Jamaica, 50 fathoms.

Astrochele Lymani Vll.

Station 307, 41° 29′ 45″ N., 65° 47′ 10″ W., 980 fathoms. Station 309, 40° 11′ 40″ N., 68° 22′ W., 304 fathoms.

Astroschema arenosum Lym.

Station 124, Santa Cruz, 580 fathoms. Station 131, Santa Cruz, 580 fathoms. Station 157, Montserrat, 120 fathoms. Station 159, Guadeloupe, 196 fathoms. Station 173, Guadeloupe, 734 fathoms. Station 227, St. Vincent, 573 fathoms. Station 269, St. Vincent, 124 fathoms. Station 281, Barbados, 288 fathoms.

Astroschema læve Lym.

Station 134, Santa Cruz, 248 fathoms. Station 156, Montserrat, 88 fathoms. Station 157, Montserrat, 120 fathoms. Station 203, Martinique, 96 fathoms. Station 216, St. Lucia, 154 fathoms. Station 218, St. Lucia, 164 fathoms. Station 219, St. Lucia, 151 fathoms. Station 224 St. Vincent, 114 fathoms. Station 231, St. Vincent, 95 fathoms. Station 249, Grenada, 262 fathoms. Station 272, Barbados, 76 fathoms. Station 273, Barbados, 103 fathoms. Station 276, Barbados, 94 fathoms. Station 290, Barbados, 73 fathoms. Station 292, Barbados, 56 fathoms. Station 296, Barbados, 84 fathoms.

Astroschema oligactes Ltk.

Station 156, Montserrat, 88 fathoms. Station 164, Guadeloupe, 150 fathoms. Station 220, St. Lucia, 116 fathoms. Station 224, St. Vincent, 114 fathoms. Station 241, Grenadines, 163 fathoms. Station 249, Grenada, 262 fathoms. Station 253, Grenada, 92 fathoms. Station 269, St. Vincent, 124 fathoms. Station 272, Barbados, 76 fathoms. Station 276, Barbados, 94 fathoms. Station 278, Barbados, 69 fathoms. Station 290, Barbados, 73 fathoms. Station 296, Barbados, 84 fathoms. Station 297, Barbados, 123 fathoms. Station 298, Barbados, 120 fathoms. Bartlett, entrance to Port Royal, Jamaica, 100 fathoms. Bartlett, Station 5, 3.3 m. S. E. by E. ½ E. from Santiago de Cuba Light, 288 fathoms.

Astroschema tenue Lym.

Station 155, Montserrat, 88 fathoms. Station 156, Montserrat, 88 fathoms. Station 269, St. Vincent, 124 fathoms. Station 276, Barbados, 94 fathoms.

Astroschema brachiatum Lym.

Bartlett, Station 5, 3.3 m. S. E. by E. ½ E. from Santiago de Cuba Light, 288 fathoms.

Ophiocreas spinulosus sp. nov.

Plate VIII. Figs. 132-135.

Special Marks. — Radial shields beset with short, blunt spines, which are continued along the upper side of the arms.

Description of an Individual (Station 269). — Diameter of disk 8 mm. Length of arm 60 mm. Width of arm, 10 mm. from disk, 2.5 mm. Height of arm at same point 3 mm. Mouth-angles well separated from each other and bearing on the upper part of their sides a number of grains which have somewhat the look of mouth-papillæ. Seven short, wide flat teeth, with a rounded cutting edge; below them is an imperfect tooth, or a couple of papillæ. Arms higher than wide, and widest above. The covering skin is smooth and rather loose, and the joints are scarcely indicated. The upper surface bears short blunt spines, a pair to each joint; but these are not found beyond the base of the arm. The first pore beyond the mouth-slit has no tentacle-scale; the second, one; and the next, two, which are cylindrical, blunt, and somewhat tapering, the lower one being about 2 mm. long, and the upper one shorter. Farther out on the arm they become more slender, and at the extreme tip take on the form of minute double hooks. Disk high and angular with interbrachial spaces re-enteringly curved. Radial shields elevated as strongly marked ridges running to the centre and thickly set with short stout blunt spines. Genital openings large and wide, reaching nearly to the roof of the disk. Color in alcohol, pale pink.

The above-described specimen was not fully grown. A large one, with a disk of 13 mm. and arms 385 mm. long, differed only in having the spines more or less obliterated on the radial shields, but much more numerous on the tops of the arms. The arm-spines, also, were comparatively shorter and stouter.

Like *Ophiocamax fasciculata*, *Ophiomusium Lymani*, and many other species, *Ophiocreas spinulosus* lives in great colonies. The tangles often came so clogged with hundreds of specimens that it was necessary to cut them off and throw the mass into alcohol. Mr. Agassiz reports the color of the living animal as brick red. A young specimen with a disk of 3 mm. had no spines on the disk or arms. Spines begin to appear only when the disk has reached 4 or 5 mm.

Station 208, Martinique, 213 fathoms. Station 216, St. Lucia, 154 fathoms. Station 233, St Vincent, 174 fathoms. Station 269, St. Vincent, 124 fathoms. Station 279, Barbados, 118 fathoms. Station 281, Barbados, 288 fathoms.

Ophiocreas lumbricus Lym.

Station 131, Santa Cruz, 580 fathoms. Station 171, Guadeloupe, 183 fathoms. Station 216, St. Lucia, 154 fathoms. Station 219, St. Lucia, 151 fath-

oms. Station 238, Grenadines, 127 fathoms. Station 263, Grenada, 159 fathoms. Station 281, Barbados, 288 fathoms.

Ophiocreas œdipus? Lym.

Station 124, Santa Cruz, 580 fathoms. Station 131, Santa Cruz, 580 fathoms.

The originals dredged by the "Challenger" at Station 344, off Ascension Island, in 420 fathoms, differed from these only in lacking all granulation on the mouth-angle. I suppose they are of the same species.

Astronyx Loveni Müll. & Tr. (Young.)

Plate VIII. Figs. 136-138.

Station 227, St. Vincent, 573 fathoms. Station 307, 41° 29′ 45″ N., 65° 47′ 10″ W., 980 fathoms. Station 338, 38° 18′ 40″ N., 73° 18′ 10″ W., 922 fathoms.

Cambridge, May, 1883.

DESCRIPTION OF PLATES.

PLATE I.

Fig. 1. *Ophiomyxa tumida*, from below; $\frac{5}{1}$.
Fig. 2. " " from above; $\frac{5}{1}$.
Fig. 3. " " arm-joints, profile; $\frac{5}{1}$.

PLATE II.

Fig. 1. *Ophiotoma coriacea*, from below; $\frac{4}{1}$.
Fig. 2. " " from above; $\frac{4}{1}$.
Fig. 3. " " arm-joints, profile; $\frac{4}{1}$.
Fig. 4. *Ophiobyrsa Perrieri*, from below; $\frac{4}{1}$.
Fig. 5. " " from above; $\frac{4}{1}$.
Fig. 6. " " arm-joints, profile; $\frac{4}{1}$.

PLATE III.

Fig. 1. *Pectinura tessellata*, from below; $\frac{3}{2}$.
Fig. 2. " " from above; $\frac{3}{2}$.
Fig. 3. " " arm-joints, profile; $\frac{3}{2}$.
Fig. 4. " *lacertosa*, from below, $\frac{1}{1}$.
Fig. 5. " " from above; $\frac{1}{1}$.
Fig. 6. " " arm-joints, profile; $\frac{1}{1}$.
Fig. 7. " *angulata*, from below; $\frac{3}{2}$.
Fig. 8. " " from above; $\frac{3}{2}$.
Fig. 9. " " arm-joints, profile; $\frac{3}{2}$.
Fig. 10. *Ophiozona marmorea*, from below; $\frac{4}{1}$.
Fig. 11. " " from above; $\frac{4}{1}$.
Fig. 12. " " arm-joints, profile; $\frac{4}{1}$.
Fig. 13. " *clypeata*, from below; $\frac{7}{2}$.
Fig. 14. " " from above; $\frac{7}{2}$.
Fig. 15. " " arm-joints, profile; $\frac{7}{2}$.
Fig. 16. *Ophiochytra tenuis*, from below; $\frac{5}{1}$.
Fig. 17. " " from above; $\frac{5}{1}$.
Fig. 18. " " arm-joints, profile; $\frac{5}{1}$.

Fig. 19. *Ophiernus adspersus*, from below; $\frac{5}{2}$.
Fig. 20. " " from above; $\frac{5}{2}$.
Fig. 21. " " arm-joints, profile; $\frac{5}{2}$.
Fig. 22. *Ophioglypha fasciculata*, from below; $\frac{3}{1}$.
Fig. 23. " " from above; $\frac{3}{1}$.
Fig. 24. " " arm-joints, profile; $\frac{3}{1}$.
Fig. 25. " *abyssorum*, from below; $\frac{3}{1}$.
Fig. 26. " " from above: $\frac{3}{1}$.
Fig. 27. " " arm-joints, profile; $\frac{3}{1}$.

PLATE IV.

Fig. 28. *Ophioglypha scutata*, from below; $\frac{1}{2}\frac{1}{1}$.
Fig. 29. " " from above; $\frac{1}{2}\frac{1}{1}$.
Fig. 30. " " arm-joints, profile; $\frac{1}{2}\frac{1}{1}$.
Fig. 31. " *tenera*, from below; $\frac{1}{2}\frac{3}{1}$.
Fig. 32. " " from above; $\frac{1}{2}\frac{3}{1}$.
Fig. 33. " " arm-joints, profile; $\frac{1}{2}\frac{3}{1}$.
Fig. 34. " *aurantiaca*, from below; $\frac{4}{1}$.
Fig. 35. " " from above; $\frac{4}{1}$.
Fig. 36. " " arm-joints; $\frac{4}{1}$.
Fig. 37. " *falcifera* (adult), from below; $\frac{5}{2}$.
Fig. 38. " " from above; $\frac{5}{2}$.
Fig. 39. " " arm-joints, profile, showing the hooked spines; $\frac{5}{1}$.
Fig. 40. " *convexa*, var. (Station 146), from below; $\frac{7}{2}$.
Fig. 41. " " from above; $\frac{7}{2}$.
Fig. 42. " " arm-joints, profile; $\frac{7}{2}$.
Fig. 43. " " (Station 206), from below; $\frac{7}{2}$.
Fig. 44. " " from above; $\frac{7}{2}$.
Fig. 45. " " arm-joints, profile; $\frac{7}{2}$.
Fig. 46. *Ophiocten Pattersoni*, from below; $\frac{7}{2}$.
Fig. 47. " " from above; $\frac{7}{2}$.
Fig. 48. " " arm-joints, profile; $\frac{7}{2}$.
Fig. 49. *Ophiomastus texturatus*, from below; $\frac{6}{1}$.
Fig. 50. " " from above; $\frac{6}{1}$.
Fig. 51. " " arm-joints, profile; $\frac{6}{1}$.
Fig. 52. *Ophiophyllum petilum?* from below; $\frac{3}{2}$.
Fig. 53. " " from above; $\frac{3}{2}$.
Fig. 54. " " arm-joints, profile; $\frac{3}{2}$.

PLATE V.

Fig. 55. *Ophiomusium Lymani* (young), from below; $\frac{1}{2}\frac{3}{1}$.
Fig. 56. " " from above; $\frac{1}{2}\frac{3}{1}$.
Fig. 57. " " arm-joints, profile; $\frac{1}{2}\frac{3}{1}$.

Fig. 58. *Amphiura incisa*, from below; $\frac{3}{2}$.
Fig. 59. " " from above; $\frac{3}{2}$.
Fig. 60. " " arm-joints, profile; $\frac{3}{2}$.
Fig. 61. " *ucreis*, from below; $\frac{1.5}{2}$.
Fig. 62. " " from above; $\frac{1.5}{2}$.
Fig. 63. " " arm-joints, profile; $\frac{1.5}{2}$.
Fig. 64. " sp. nov.? (Station 220), from below; $\frac{3}{2}$.
Fig. 65. " " from above; $\frac{3}{2}$.
Fig. 66. " " arm-joints, profile; $\frac{3}{2}$.
Fig. 67. *Ophiochiton tenuispinus*, from below; $\frac{3}{1}$.
Fig. 68. " " from above; $\frac{3}{1}$.
Fig. 69. " " arm-joints, profile; $\frac{3}{1}$.
Fig. 70. *Ophiacantha Bairdi* from below; $\frac{7}{2}$.
Fig. 71. " " from above; $\frac{7}{2}$.
Fig. 72. " " arm-joints, profile; $\frac{7}{2}$.
Fig. 73. " *Bartletti*, from below; $\frac{5}{2}$.
Fig. 74. " " from above; $\frac{5}{2}$.
Fig. 75. " " arm-joints, profile; $\frac{5}{2}$.
Fig. 76. " *cervicornis*, from below; $\frac{3}{1}$.
Fig. 77. " " from above; $\frac{3}{1}$.
Fig. 78. " " arm-joints, profile; $\frac{3}{1}$.

PLATE VI.

Fig. 79. *Ophiacantha lineolata*, from below; $\frac{2}{1}$.
Fig. 80. " " from above; $\frac{2}{1}$.
Fig. 81. " " arm-joints, profile; $\frac{2}{1}$.
Fig. 82. " *lævipellis*, from below; $\frac{1.5}{2}$.
Fig. 83. " " whole disk from above, to show the varied covering; $\frac{1.5}{2}$.
Fig. 84. " " arm-joints, profile; $\frac{1.5}{2}$.
Fig. 85. " *scolopendrica*, from below; $\frac{5}{2}$.
Fig. 86. " " from above; $\frac{5}{2}$.
Fig. 87. " " arm-joints, profile; $\frac{5}{2}$.
Fig. 88. *Ophiothamnus vicarius?* (young), Station 190, 542 fathoms; $\frac{2.5}{1}$. The entire back of the disk is shown, beset with shafts, each bearing a bunch of three or more sharp, slender thorns. These show the embryonic form of the thorny stumps so common in Ophiacantha and allied genera. Only two joints of the short arms are represented.
Fig. 89. *Ophiomitra incisa*, from below; $\frac{5}{2}$.
Fig. 90. " " arm-joints, profile; $\frac{5}{2}$.

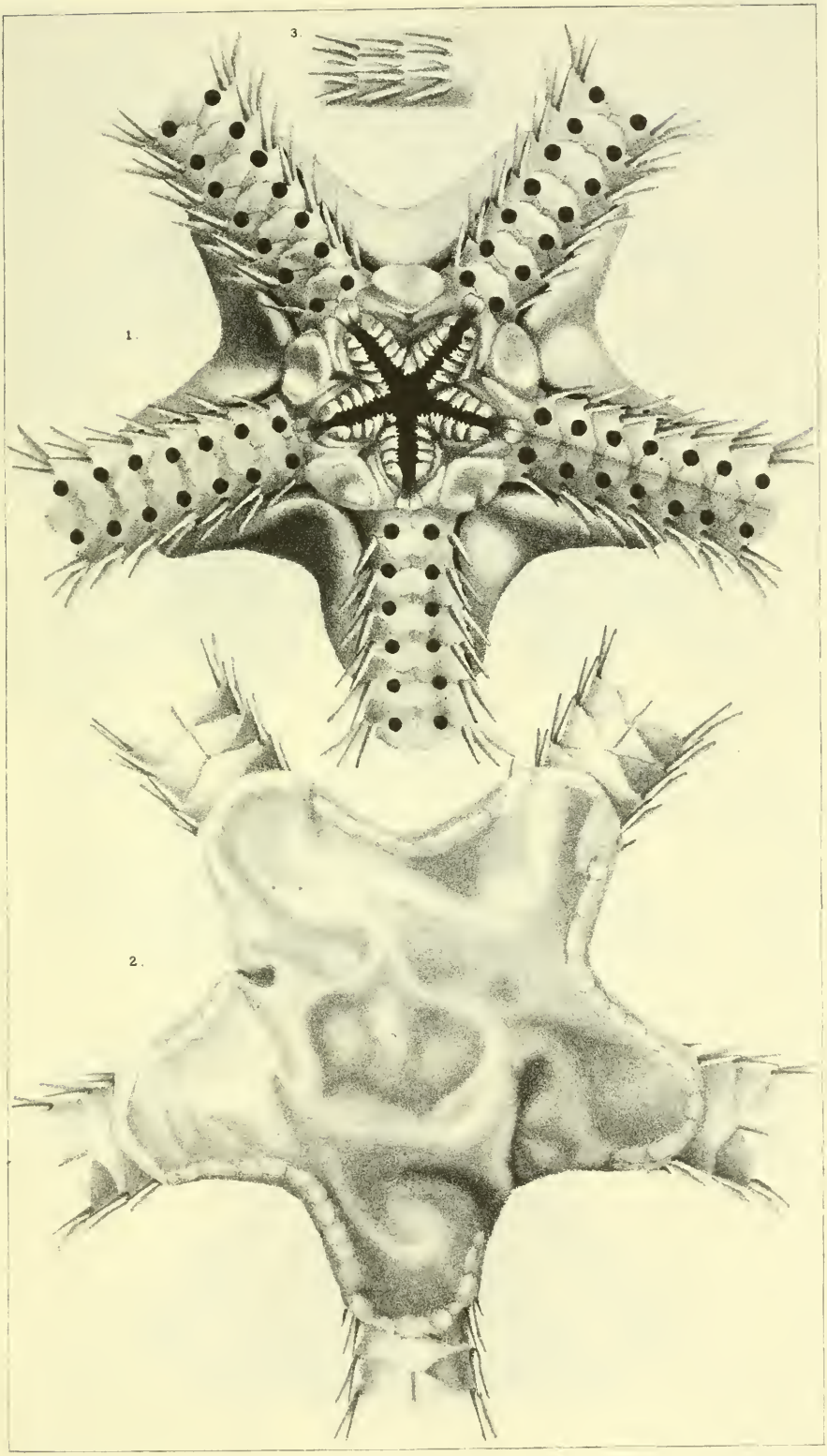
PLATE VII.

Fig. 91. *Ophiomitra incisa*, from above; $\frac{5}{2}$.
Fig. 92. *Ophiocamax fasciculata*, from below; $\frac{2}{1}$.
Fig. 93. " " from above; $\frac{2}{1}$.
Fig. 94. " " arm-joints, profile; $\frac{2}{1}$.
Fig. 95. *Ophiocopa spatula*, from below; $\frac{4}{1}$.
Fig. 96. " " from above; $\frac{4}{1}$.
Fig. 97. " " arm-joints, profile; $\frac{4}{1}$.
Fig. 98. " " one of the flattened arm-spines; $\frac{10}{1}$.
Fig. 99. *Ophiosciasma granulatum*, from below; $\frac{5}{1}$.
Fig. 100. " " from above; $\frac{5}{1}$.
Fig. 101. " " a flattened arm-spine in its skin-bag; $\frac{45}{2}$.
Fig. 102. " " arm-joints; $\frac{5}{1}$.
Fig. 103. *Ophiogeron supinus*, from below; $\frac{3}{2}$.
Fig. 104. " " from above; $\frac{3}{2}$.
Fig. 105. " " joints at tip of arm, from below; $\frac{5}{1}$.
Fig. 106. " " joints at tip of arm from above showing absence of upper arm-plates, and division of arm-bones into halves; $\frac{5}{1}$.
Fig. 107. " " joints at tip of arm, profile; $\frac{5}{1}$.
Fig. 108. *Ophiochondrus squamosus*, from below; $\frac{6}{1}$.
Fig. 109. " " from above; $\frac{6}{1}$.
Fig. 110. " " arm-joints, profile; $\frac{6}{1}$.
Fig. 111. " *crassispinus*, from below; $\frac{7}{1}$.
Fig. 112. " " from above; $\frac{7}{1}$.
Fig. 113. " " arm-joints, profile; $\frac{7}{1}$.

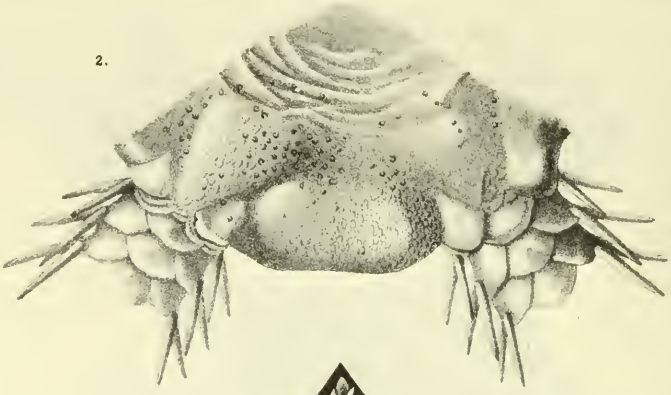
PLATE VIII.

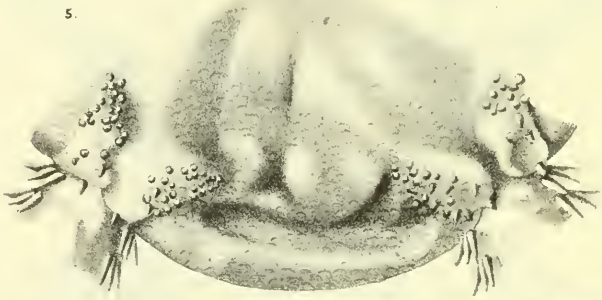
Fig. 114. *Ophiomyxa serpentaria*, from below; $\frac{2}{1}$.
Fig. 115. " " from above; $\frac{2}{1}$.
Fig. 116. " " arm-joints, profile: $\frac{2}{1}$.
Fig. 117. *Ophiobyrsa serpens*, from below; $\frac{2}{1}$.
Fig. 118. " " from above; $\frac{2}{1}$.
Fig. 119. " " arm-joints, profile; $\frac{2}{1}$.
Fig. 120. " *hystricis*, from below, showing the large tentaeles; $\frac{2}{1}$.
Fig. 121. " " from above; $\frac{2}{1}$.
Fig. 122. " " arm-joints, profile; $\frac{2}{1}$.
Fig. 123. *Hemieuryale tuberculosa*, from below; $\frac{7}{2}$.
Fig. 124. " " from above; $\frac{7}{2}$.
Fig. 125. " " base of arm, profile; $\frac{7}{2}$.
Fig. 126. " " joints from middle of arm, from above; $\frac{7}{2}$.
Fig. 127. " " joints near tip of arm, profile; $\frac{7}{2}$.

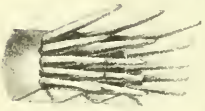
Fig. 128. *Ophiobrachion uncinatus*, from below; $\frac{1}{1}$.
Fig. 129. " " from above; $\frac{1}{1}$.
Fig. 130. " " arm-joints, profile. The arm-hooks have all fallen, leaving their little mamelons; $\frac{1}{1}$.
Fig. 131. " " an arm-hook; $\frac{8}{1}$.
Fig. 132. *Ophiocreas spinulosus*, from below; $\frac{3}{1}$.
Fig. 133. " " from above; $\frac{3}{1}$.
Fig. 134. " " joints near base of arm, profile; $\frac{3}{1}$.
Fig. 135. " " joints near tip of arm, profile; $\frac{3}{1}$.
Fig. 136. *Astronyx Loveni* (young), from below; $\frac{1}{2}\frac{1}{1}$.
Fig. 137. " " from above; $\frac{1}{2}\frac{1}{1}$.
Fig. 138. " " arm-joints, profile; $\frac{1}{2}\frac{1}{1}$.

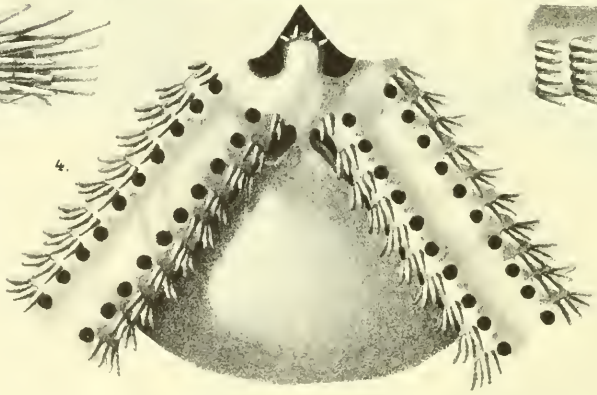


L Trouvelot on stone. Keith Peirson ad nat. Printed by A.Meisel

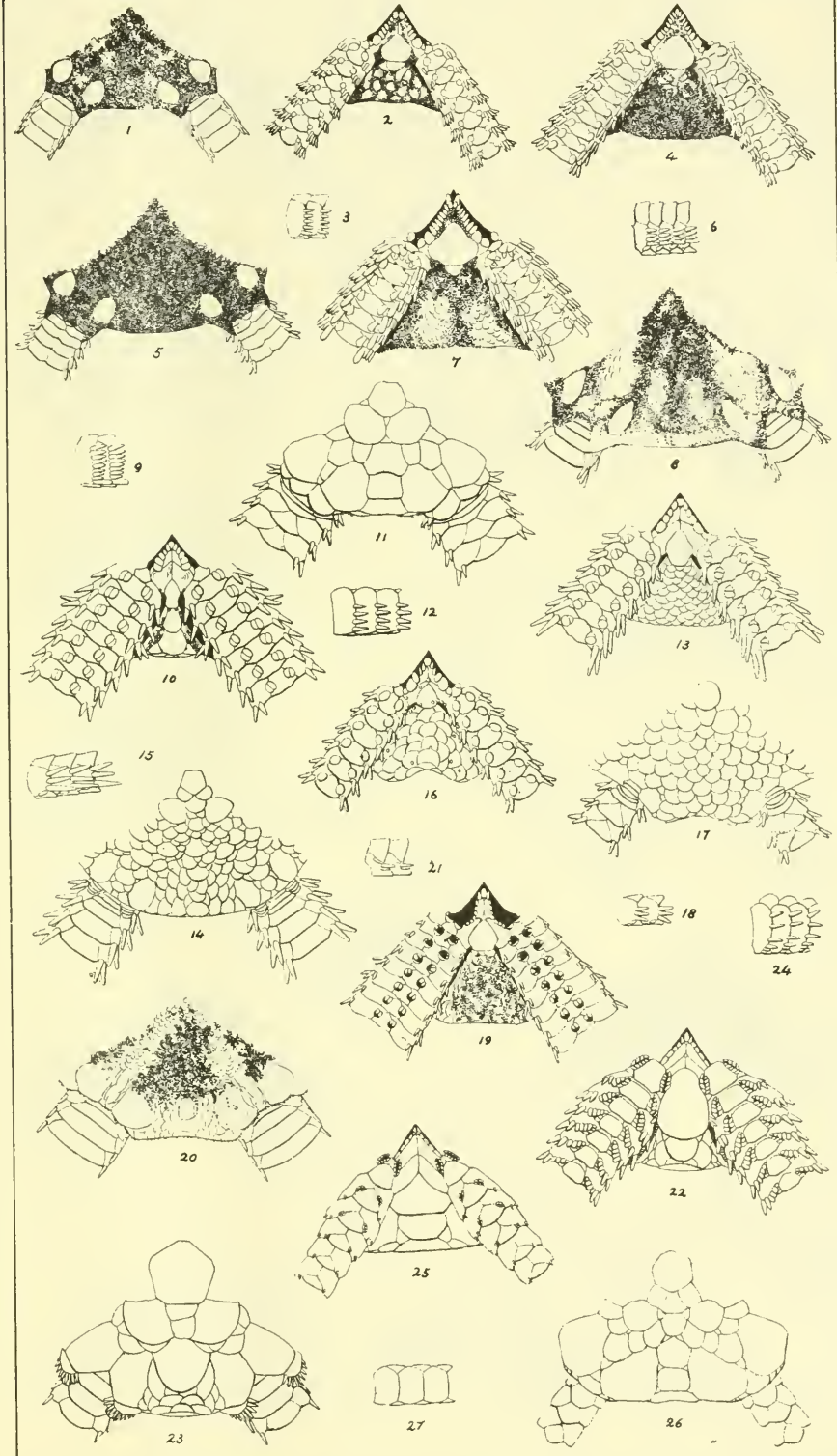








L. Trouvelot on stone. Kath. Peirson ad. nat. Printed by A. Meisel.



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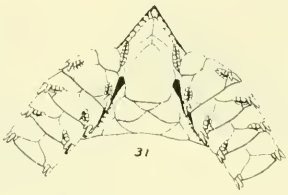
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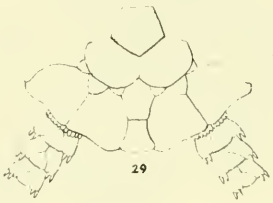
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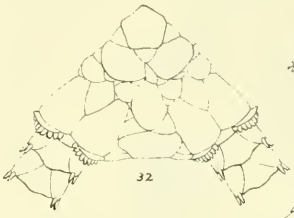
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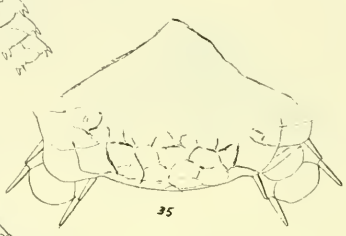
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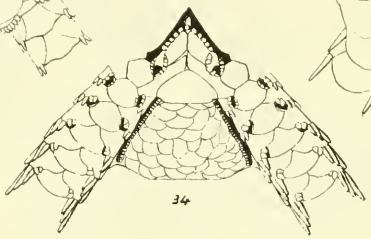
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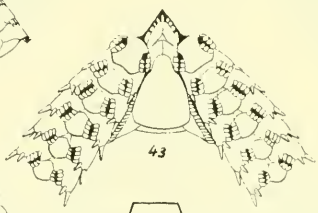
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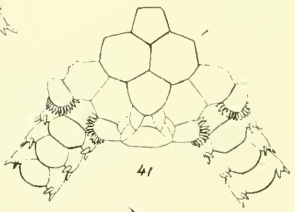
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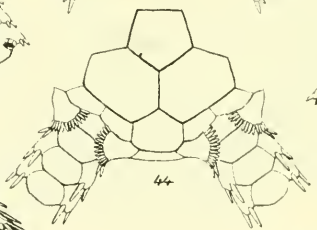
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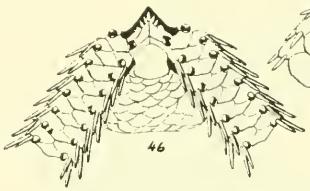
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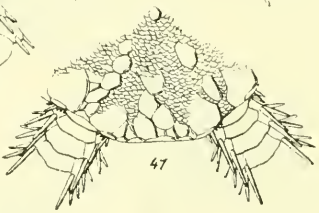
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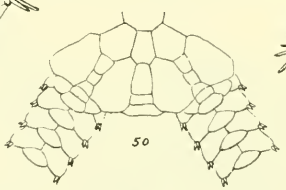
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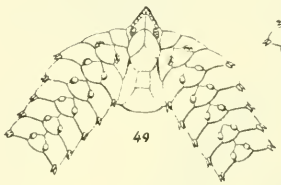
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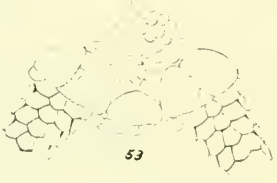
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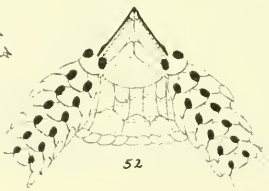
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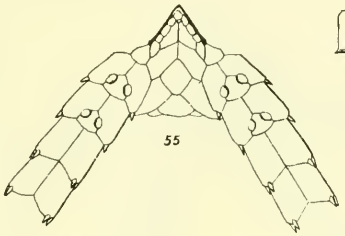
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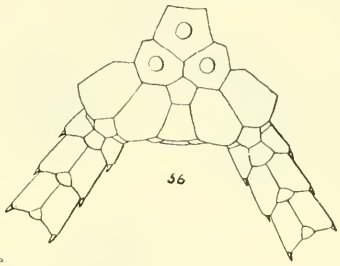
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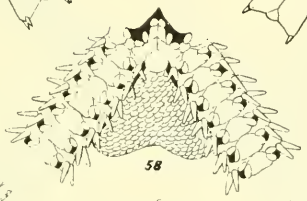
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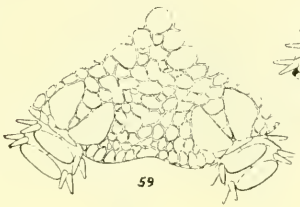
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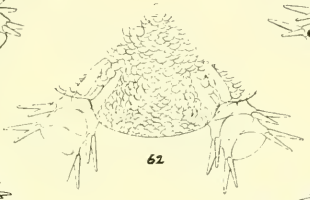
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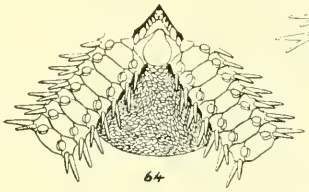
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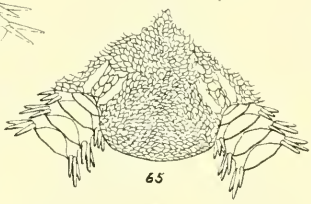
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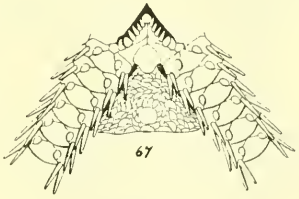
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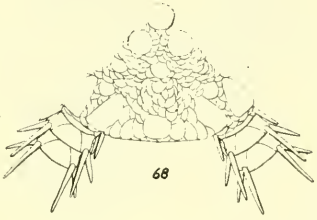
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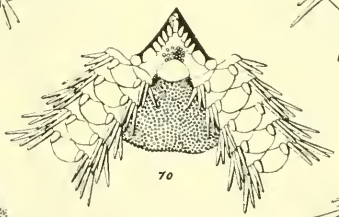
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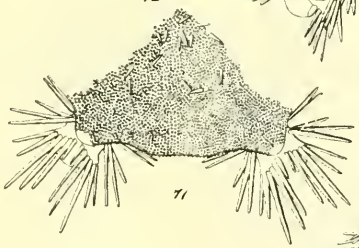
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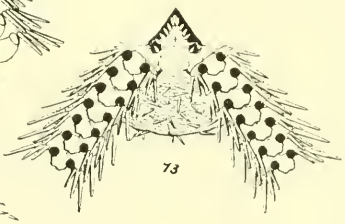
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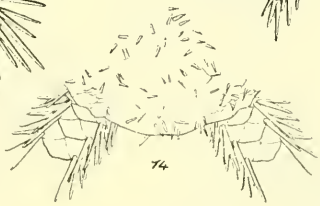
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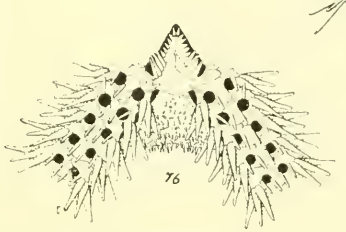
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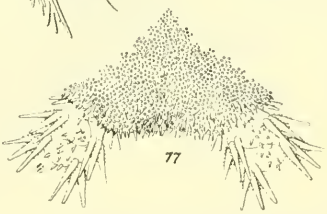
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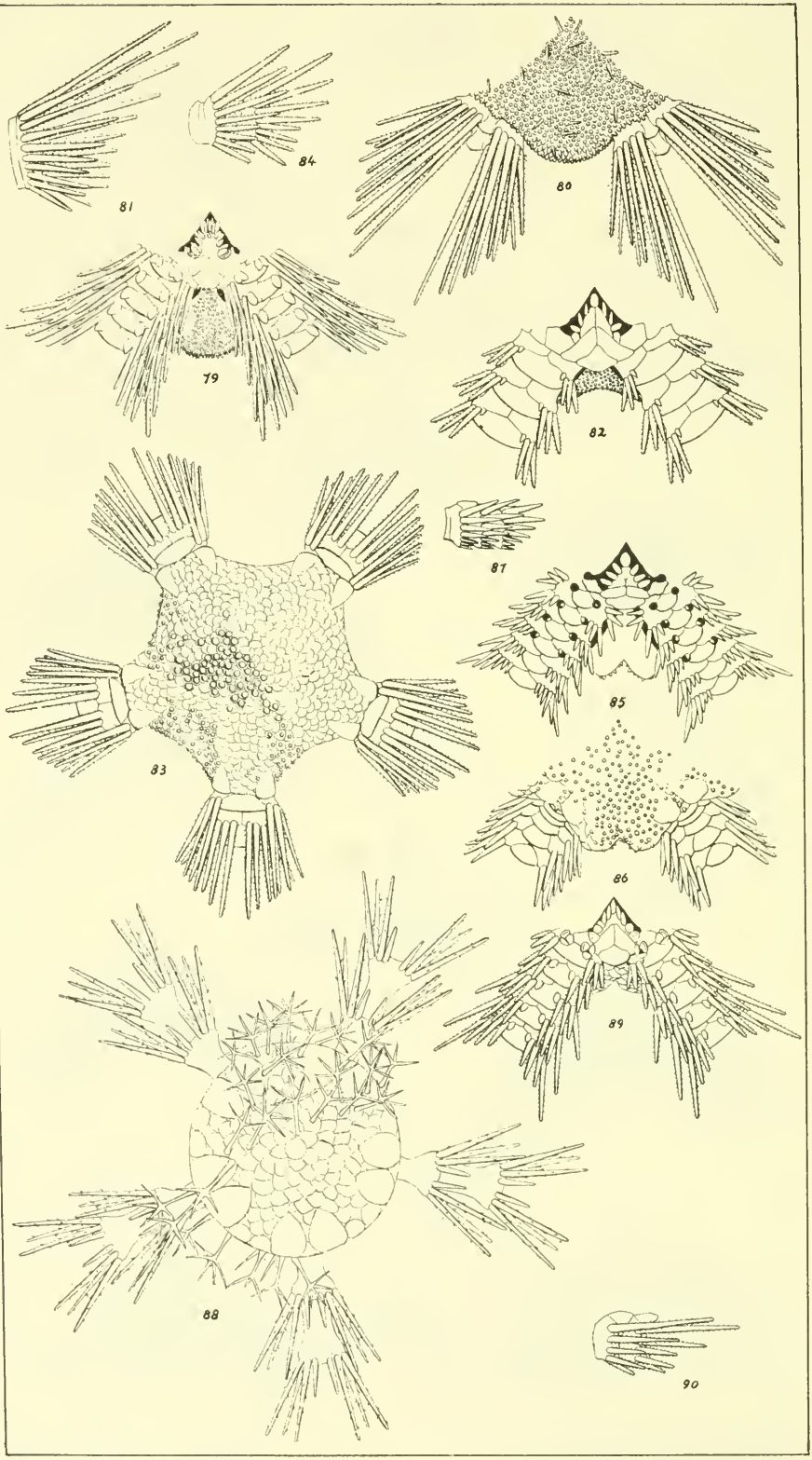

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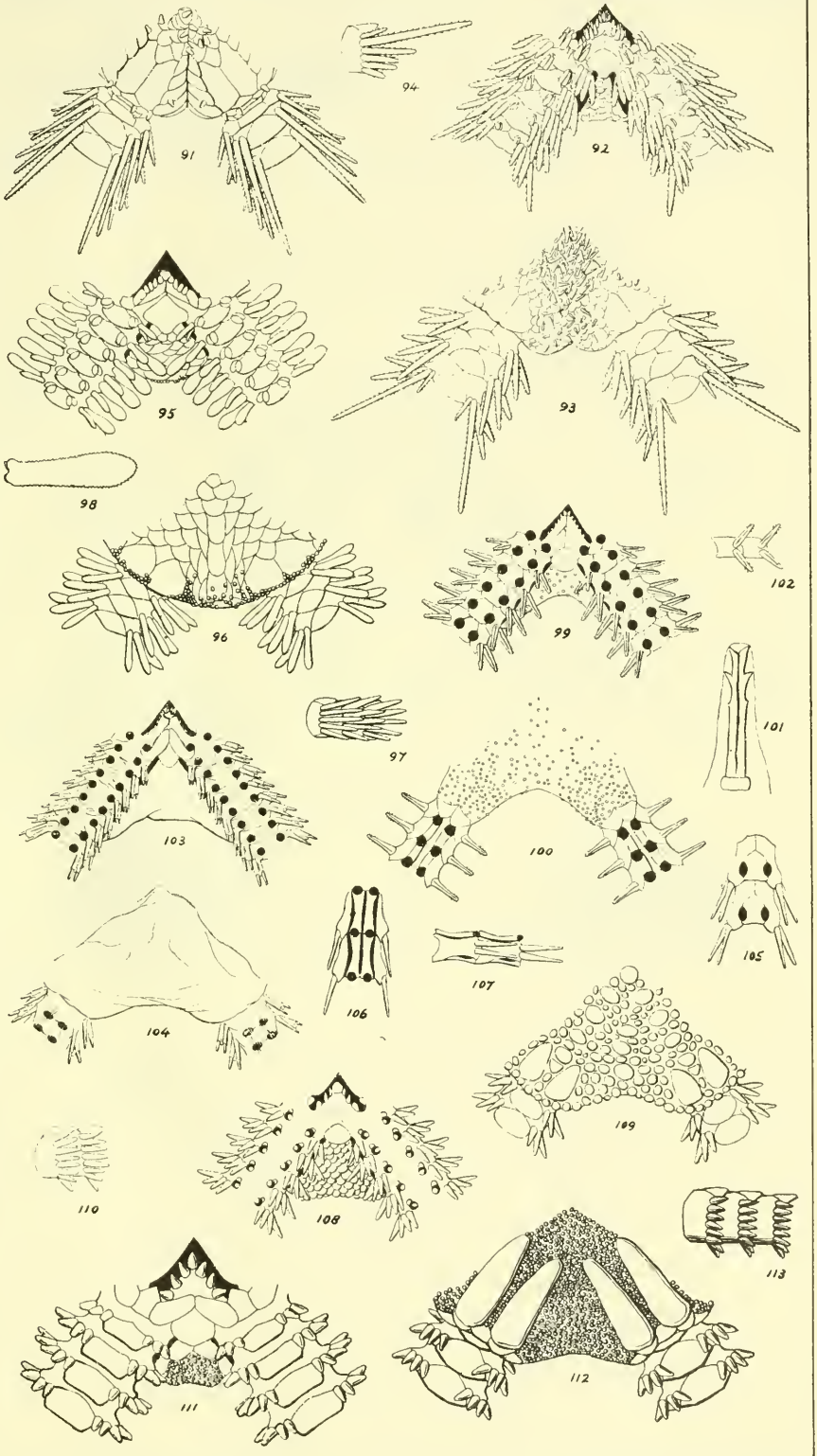

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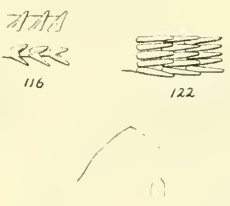
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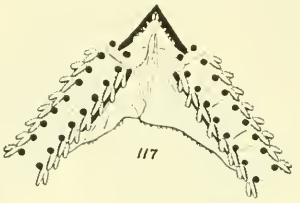
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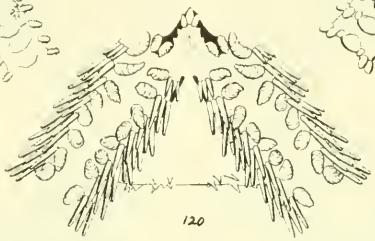
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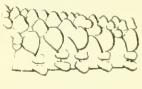
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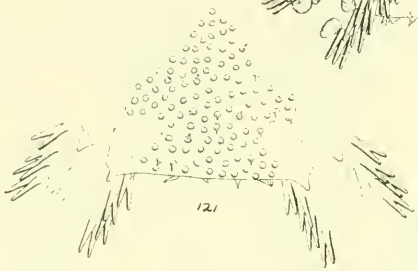
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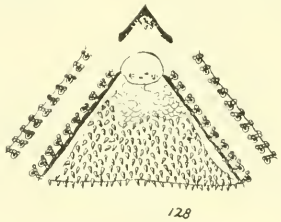
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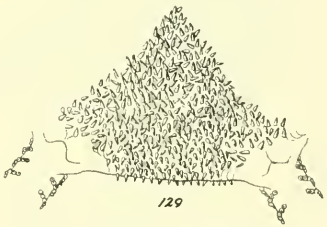
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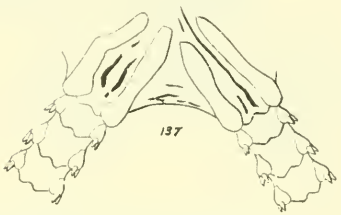
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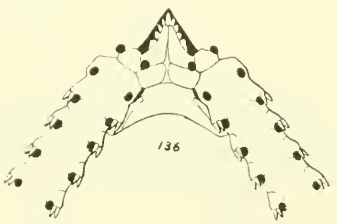
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